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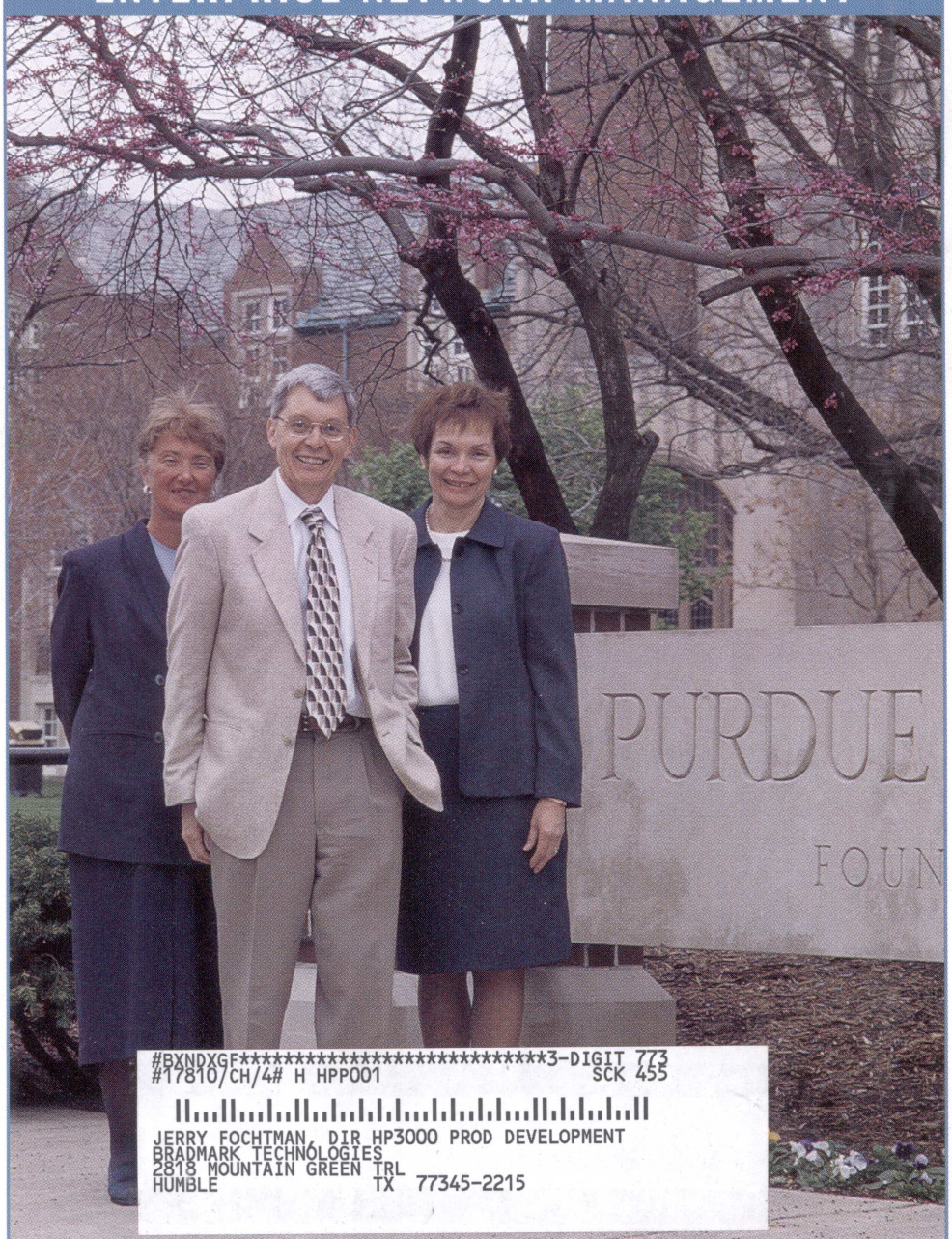
HP Professional

JUNE 2000

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ENTERPRISE NETWORK MANAGEMENT



Purdue's IT Management Team: (left to right) Nancy Yuochunas, Laverne Knodle and Susan Gothard

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System Configuration Repository

On the Server Side
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SPECIAL REPORT

HP OpenView and Network Management

A 101communications Publication

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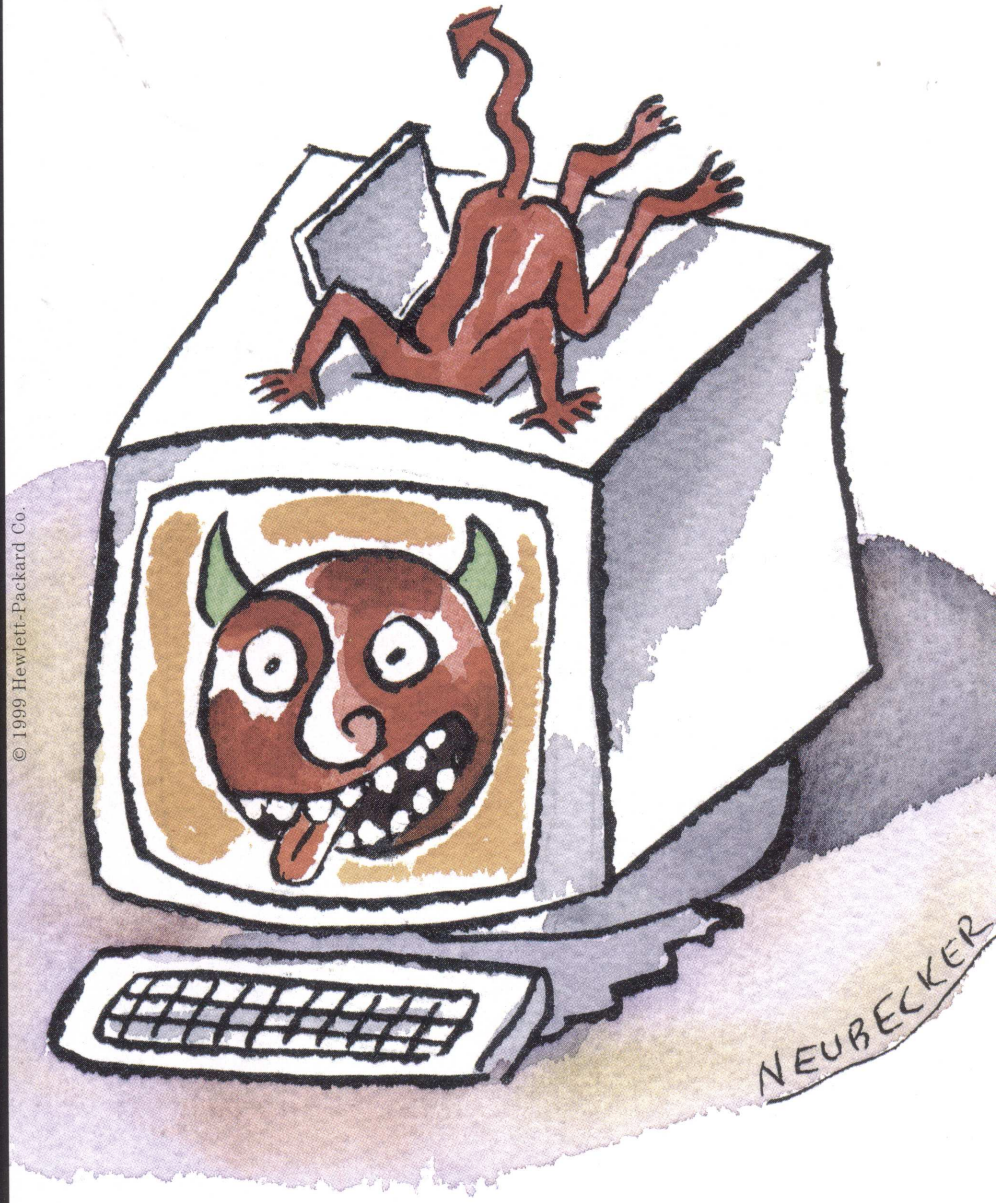
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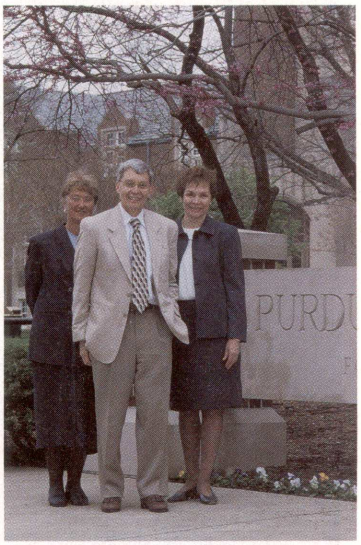
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JUNE 2000

HP Professional

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Cover Photo by Nick Judy

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Data. It is accumulating so rapidly, and in so many different sources, that organizations are struggling to consolidate the information and provide access to it across the enterprise and within the supply chain. UNIX is becoming a major platform for data warehousing, and HP-UX servers provide the scalability needed to run BI/DW solutions. **By Lawrence Brooks**

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One of the nation's largest healthcare providers faced a daunting challenge: Overhauling its aging computer infrastructure to handle the complexities of a national enterprise serving nine million members. Recognizing that it needed to augment its internal resources to carry out a project of this scope, the company engaged The Axean Group to design and architect an optimized, high-availability, scalable solution. **By Victor Tayao**

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HP PROFESSIONAL ISSN 0896-145X is published monthly by 101communications LLC, 9121 Oakdale Ave., Suite 101, Chatsworth California, 91311. Subscriptions are complimentary for qualified U.S. and Canadian sites. Periodicals postage paid at Chatsworth, CA 91311, and additional mailing offices. For address changes and other subscription information in the U.S.: hp@omeda.com or call (800) 306-6332. Outside the U.S., call (847) 291-5212 or fax (847) 564-9002. In the U.S., missed issues must be claimed within 45 days of the publication date; outside the U.S., missed issues must be claimed within 90 days. Editorial and advertising sales offices at 1300 Virginia Dr., Ste. 400, Fort Washington, PA 19034 • tel: (215) 643-8000, fax: (215) 643-3901.

US POSTMASTER: Send all correspondence and address changes to HP PROFESSIONAL, P.O. Box 3053, Northbrook, IL 60065.

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CANADIAN POSTMASTER: Send all correspondence and address changes to 101communications LLC, C/O N.I., P.O. Box 44, RPO Rockwood Mall, Mississuaga, ON L42 9Z9.

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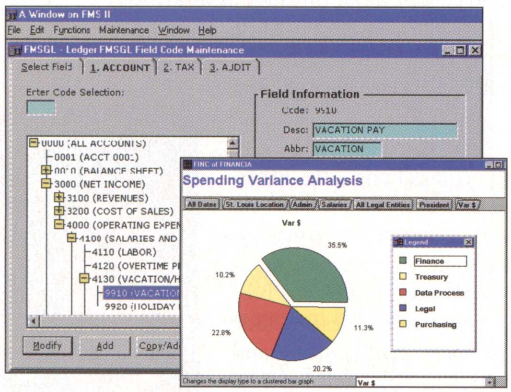
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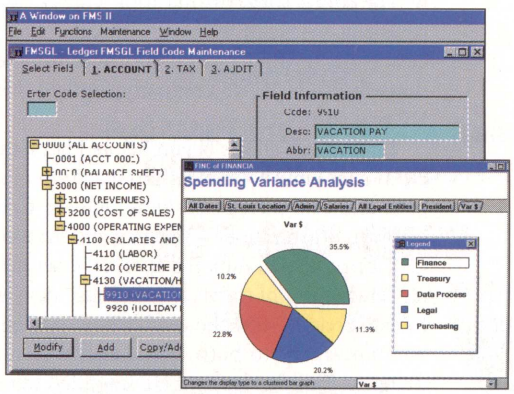
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Think What a Difference a Year Makes

Think back to a year ago. HP was virtually leaderless, engaged in a search for a new CEO. The company was plagued by lackluster sales in Asia, lagging UNIX sales in North America, an organizational structure that seemed to cripple innovation and nimbleness, and the widespread notion that the Internet revolution had left it sitting on the sidelines.

By the time Carly Fiorina took charge last July, HP had begun to turn things around. Asian problems were diminishing. The company was spewing forth new products and new initiatives. Lew Platt, trying to make HP more nimble, was spinning off its test and measurement operations into a separate company, Agilent Technologies. As Fiorina took the helm, HP picked up the pace.



Building on efforts begun before Platt retired, Fiorina consolidated what she called HP's "silos" into four main groups: Two customer-facing organizations – the Enterprise and Commercial Business, and the Consumer Business – and two product and platform organizations – Imaging and Printing Systems, and Computing Systems.

Fiorina also hammered hard on e-services, identifying three new business models flowing out of them: apps-on-tap, next-generation portals and dynamically brokered services. And she established "strategic choices," or priorities. These include a commitment to both UNIX and NT, storage, PCs, services, and printing and imaging. Fiorina also said HP intended to exploit its position at "the intersection of e-services, infrastructure, and appliances."

It wasn't just talk. HP has teamed up with service providers like Qwest and USinternetworking to deliver apps-on-tap. It has entered the portal space, first by focusing on enterprise information portals and then, this May, by jumping into the market for trading exchanges and personalized portals. The company even introduced a new business model for portals – Channels-on-Tap.

Dynamically brokered services are core to HP's e-services strategy, and they rest, of course, on the company's e-speak technology. HP has set up a developer's site to promote e-speak and has integrated OpenView, its widely used system management software, into the new technology.

Then there are the other areas Fiorina mentioned: UNIX and NT, storage, PCs, printing and digital imaging, and infrastructure. While UNIX sales are healthy, HP needs to do better in the North American market. On the NT front, the company has unveiled new NetServers and programs and services for users migrating to Windows 2000.

Storage – well, the announcements just keep coming. Equally important, Fiorina has consolidated the separate storage groups once defined by platform into one large organization.

As for the lucrative printing and imaging business market, well HP provides about half of the printers sold.

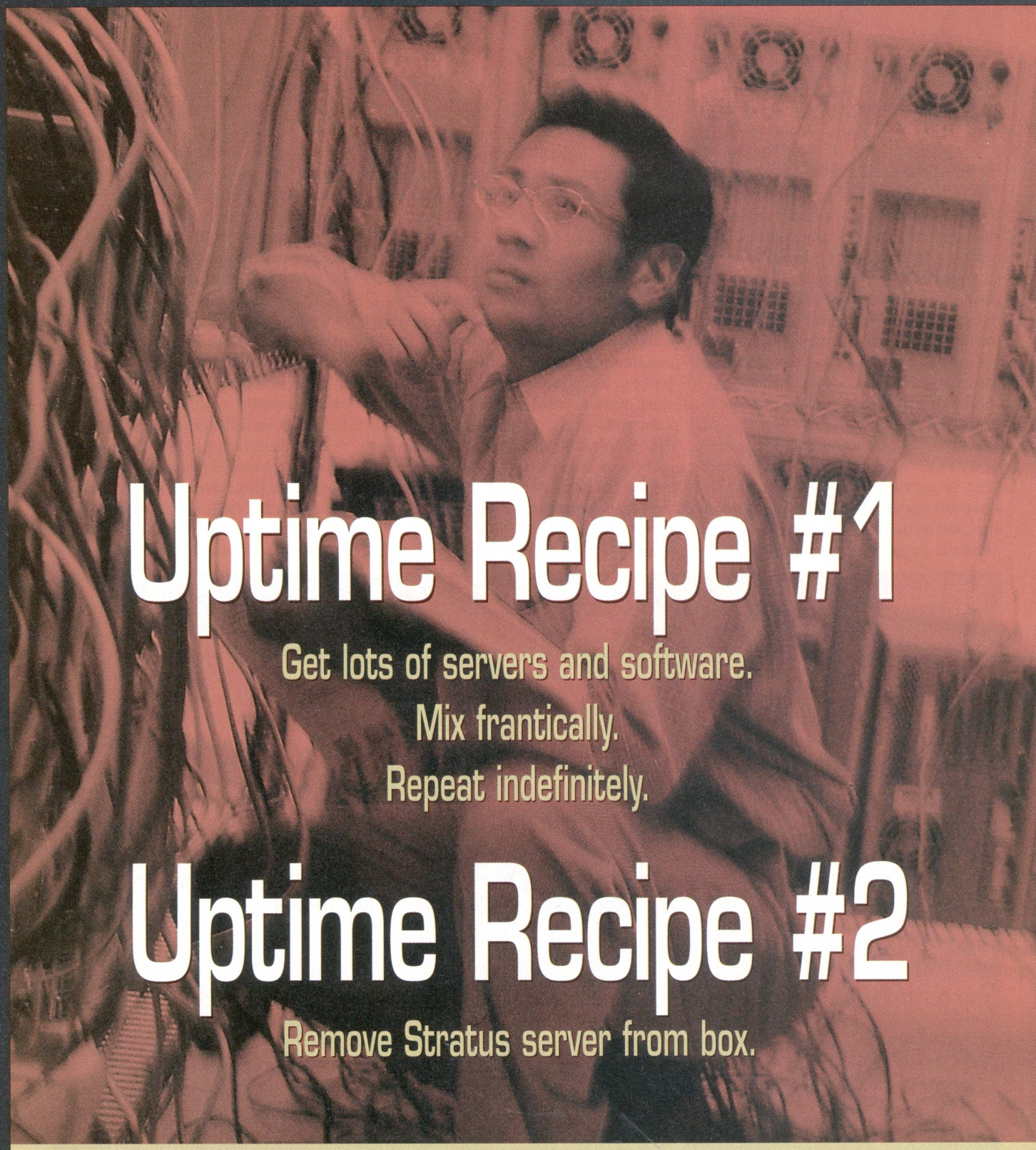
As far as infrastructure is concerned, HP has introduced its IP-Billing-on-Tap and Infrastructure-on-Tap initiatives. These are intended to further HP's vision of Internet utility computing – of digital information moving as dependably as water flowing from the tap or flowing as effortlessly as electricity through a lamp.

In all its interests in new markets, HP didn't overlook a loyal part of its installed base – HP 3000 users. The HP 3000 has morphed into the HP e-3000, an Internet-ready machine.

This all stacks up to a lot of progress. But, HP still has a way to go. It remains a hardware vendor and must rely heavily on partnerships. It's essential that e-speak catch on. And the competition isn't standing still. HP's services business remains a fraction of IBM's, and Sun continues to cut a wide swatch in the high-end UNIX market. All that aside, HP's fortunes look much brighter than they did a year ago.



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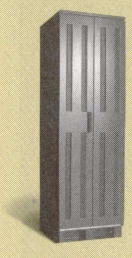


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HP PARTNERS TO BRING PRINTING TO THE NET

If HP's e-services strategy sometimes seems synonymous with "e-partnerships," the company's recent print and imaging announcement only reinforces the notion that it intends to drive its Internet strategy through alliances. The announcement also reveals a trend that's gaining momentum at HP – the company has either invested in its new allies, or will share in their revenues.

The new initiatives, designed to elevate "HP's printing and imaging business to a new level," according to company President and CEO Carly Fiorina, fall into three main categories: services, infrastructure and print appliances. Of these, the services area seems most fleshed out. HP is partnering to give users the ability to print plane or theater tickets, manuals, coupons, insurance policies and international newspapers. While that may save time for users, it means profits for HP.

HP's new partners include FedEx, NewspaperDirect.com, ImageTag, PrintCafe, Mimeo.com, Stamps.com and Encryptix.com. The alliance with FedEx makes HP their printer of choice for printing electronic mailing labels with inkjet printers. ImageTag software allows users to store, retrieve and send documents using uniquely bar-coded labels called Post-it eFlags. PrintCafe, an online exchange for bidding on large print jobs, will use HP's e-speak brokering technology. Newspaper.com prints international newspapers locally. Mimeo.com is offering a printing service that allows users to send print jobs electronically to its printing facility in Tennessee, from which FedEx ships the completed jobs to their destinations.

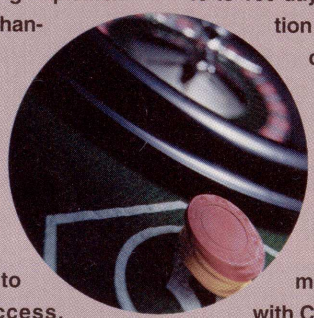
Stamps.com and Encryptix.com will allow users to print theater tickets, boarding passes and other such items.

On the infrastructure front, HP and its subsidiary Dazel have developed a document router that ensures delivery of important business documents.

HP's new print appliances are the HP JetDirect 4000 and the HP Jornada 540 Series Color Pocket PC. The JetDirect 4000 is the first in what will be a family of network appliances that allow IT managers to manage print queues with a browser. The Jornada 540 Series Color Pocket PC can beam color images to color printers with the tap of a stylus.

HP Bets Big on Portals

In a much-publicized announcement presided over by Nick Earle, President of HP's E.Services.Solutions organization, HP unveiled new solutions and a bevy of new partners in the Web portal space. The portal solutions break down into four main areas: the HP Enterprise Business Portal Solution, developed in conjunction with BroadVision and intended to bring personalization to portals; a Trading Community Architecture, designed by HP; expanded HP consulting services, including implementation of a portal pilot in 45 to 100 days; and HP Channels on Tap, a "marketplace" portal ecosystem.



HP's Enterprise Business Portal Solution hinges on a partnership with BroadVision, a provider of personalized e-business applications, and includes a package of hardware, software, services and support that allows companies to build portals for customers, partners and employees. "Stickiness" – the ability to retain customers – is essential to portal success, according to BroadVision CEO Pehong Chen, whose company's software is intended to facilitate customer retention. The HP Enterprise Business Portal Solution offers a pre-integrated gateway for business content, commerce and collaboration, and includes components for specific customer needs. The solution, including consulting, support and services, will be delivered through the HP E-Services Support Center.

The Trading Community Architecture hinges on HP's relationship with Moai Technologies, a company in which HP has just invested. Moai's LiveExchange technology, which will be integrated into HP trading community solutions and the HP Enterprise Business Portal Solution, facilitates interaction between networks of trading exchanges. Ann Perlman, Moai's CEO, explains what her company's technology brings to the party, by pointing out that it's easier for businesses to gather buyers and sellers from a vertical industry or sub-segment, rather than make a completely new entrance into the portal space.

HP's consulting services offer a portal roadmap, an ROI plan and a project blueprint. HP also promises rapid implementation – development of a portal pilot that's up and running in 45 to 100 days. HP consulting services for enterprise information portals are already available. Services for trading communities and e-commerce are scheduled for availability in the next two months.

HP Channels on Tap allows customers to purchase hosted services through a local agent – a reseller or integrator – who has access to a pre-qualified set of service providers. Touted by HP as a new business model, the solution is being offered in conjunction with CSDev and Solution.com.

Why is HP so high on portals? In a conversation with *HP Professional*, Keith Melbourne, General Manager of HP's Trading Community Business Unit, came up with some numbers. "The overall technology market in North America today is $400 billion, of which $300 billion is the traditional IT market and $100 billion the Internet-related market," Melbourne points out. By 2003, however, not only will the number change but so will the percentages. By then, the total IT market will climb to $600 billion, and 50 percent of that, or $300 billion, will be Internet-related. Of that $300 billion, two-thirds will be portal-related. "That makes the portal market in excess of $75 billion and as high as $200 billion by 2003," Melbourne says. "The portal space will be a huge driver of consulting services, hardware, networking software, and so on," Melbourne notes.



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The Buzz

PRINT ADVANTAGE UNVEILED

HP has unveiled PrintAdvantage, a procurement and service plan that delivers printers, toner supplies and support to departments, sites or entire companies looking for a print management solution.

PrintAdvantage allows users to choose any combination of HP LaserJet printers (color or monochrome) and pay for the products on a monthly basis, according to estimated usage. The monthly fee includes service, support and supplies, and is fixed according to the customer's toner usage model for 12 months. Contracts run for three, four or five years.

HP is touting PrintAdvantage as a usage-based program, one that offers significant advantages over traditional cost-per-page programs that set minimum monthly volumes. Through use of a sophisticated quotation tool that takes into account the type of hardware (desktop, network or multifunction printers) and total number of pages printed (adjusted for graphics), customers can estimate how many pages they print each month. They are then charged according to their usage.

PrintAdvantage is offered through qualified resellers and requires an initial order of $50,000.

HP, EVERYPATH ALLY ON MOBILE E-SERVICES

HP and Everypath Inc. have forged a partnership to co-develop and co-market a new wireless Net service that allows companies to deliver personalized e-services to mobile workers. The new service will let users of mobile devices, such as smart phones and Palm Inc.'s Palm VII organizer, connect at any time to the Web services most important to them – e-banking, stock trading, online auctions and so on. The service also enables users to conduct e-commerce transactions from their devices.

The wireless e-services solution will be provided by HP, which will integrate Everypath technology into a hosting environment that features HP's UNIX and Windows NT hardware, along with HP network management services and firewall and intrusion protection software. The Everypath technology eliminates the need to reprogram existing sites in order to provide wireless access and enables mobile users to perform secure transactions in real time. HP and Everypath also are working on an e-speak adapter to Everypath's Rendering Tool to accelerate the process for creating e-speak applications for mobile devices.

PA-8700 Chip Details Revealed

HP has revealed details of its 64-bit PA-8700 processor, designed for servers and workstations. The PA-8700, released to manufacturing in late March, is scheduled to ship in the first half of 2001. The chip, which will work with UNIX, Linux and the upcoming 64-bit version of Windows, will run at frequencies of 800 MHz and above.

The PA-8700 employs a .18 micron, silicon-on-insulator copper CMOS process. That process allows for 2.25 MB of on-chip cache, the largest of any microprocessor and a 50 percent increase over the PA-8600. HP says that the new .18 micron process reduces voltage, which significantly lowers power consumption when the chip operates at higher frequencies, and results in cooler operation. The process also enables the PA-8700 to calculate up to 3.2 billion operations per second.

HP is targeting the PA-8700 against Sun's UltraSPARC III. The PA-8700's integer and floating point performance, HP claims, will be at least 64 percent and 14 percent better, respectively, than that for the Sun chip.

HP plans to introduce two new chips in the PA-RISC line – the PA-8800, probably sometime in 2002 – and the PA-8900, scheduled for delivery well beyond that. This means the company intends to maintain parallel product lines – PA-RISC and IA-64 – well beyond 2002.

MICROSOFT PRESENTS POCKET PC

Microsoft's new Pocket PC represents the company's third strike at the handheld device market, which Dataquest predicts will increase from $7.2 billion in sales in 1998 to $32.5 billion in 2002. In two previous attempts, Microsoft has failed to nab a healthy share of the market, mainly because its Windows CE operating system proved too large and slow for handhelds.

The Pocket PC runs a revamped version of CE – Version 3.0. The handheld features a personal information manager (PIM) that includes calendar, contacts, inbox, tasks and notes; a Web browser specially designed for handhelds; slimmed-down versions of Word and Excel; Windows Media Player; and Microsoft Reader, with Microsoft ClearType display technology. Those features pack some punch, allowing handheld users to keep appointments, play music files and surf the Web.

The hardware manufacturers have given the handhelds some clout – the Pocket PCs feature 32-bit processors and 16 to 32 MB of memory. The vendors also are giving them a fairly reasonable price tags – $299 to $599.

HP's new Jornada 540 Series Color Pocket PCs fall at the higher end of the price range. The Jornada 540 and 545, featuring 16 MB of RAM are priced at about $499. The Jornada 548, boasting 32 MB of RAM is priced at about $599.

HP also is offering two wireless bundles for the Jornada 540s, both from Socket Communications. The Socket Digital Phone Card and cable, available for about $150, connect a Pocket PC to a CDMA or GSM mobile phone to enable wireless Internet access, e-mail, message service and remote access to organizational servers.

ORACLE SHIPS INTERNET FILE SYSTEM

Oracle's Internet File System (iFS), a significant piece of the Oracle 8i database, has begun shipping. Touted by Oracle as "the first file system built for the Internet," iFS is designed to give 8i users the ability to manage a wide range of information, including Web pages, e-mail and video. iFS allows developers to enhance simple file system capabilities through automatic version control, check-in/check-out, and advanced search. Oracle says that iFS can be used to create advanced Web applications, like corporate portals, that span over 150 file types. iFS is designed to automate what developers now do in hand-coding file system capabilities, like version control. ◆

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HP, Cisco, Software.com and Service Providers Team to provide Unified Communications

Business communications and the requisite personal communication devices have come of age in the mid- to late-1990s. Unfortunately, today we sometimes end up with too much of a good thing. The functions these devices play in our business (and personal) lives are incredibly important and are seen everywhere by people who need to stay in touch while on the go pass by.

Not long ago, a sales person was spotted at a large city airport sporting a cellular phone clipped to his belt, while two pagers were attached in matching leather holsters on his suspenders. A laptop with e-mail and fax capability built in hung over a shoulder strap. Despite the arsenal of communication tools at his beck and call, the individual was busily placing coins into a public phone to contact his office.

This true-life example reminds us all that it is high time someone stepped up to regain control over our various business and personal communications tools. The good news is that HP, Cisco and Software.com have partnered to unify the overabundance of communications. In short, the hp-cisco-sw.com offering will afford a way for service providers to deliver unified communications services that allows business customers to send, receive and manage real-time communication by consolidating key technologies into one universally accessible mailbox, available anywhere and at any time. This will dramatically change the way business users and consumers use their various communication devices.

Internet applications increasingly include voice communications and the two are on a merger path. The ubiquitous Web browser is becoming the standard for messaging access across all applications. Ever mindful of cost, business's have been seeking a unified, singular solution to address today's various and burdensome heterogeneous messaging solutions.

With Unified Communications, end users can:

- Access voice, e-mail, and fax messages over the phone, Web, or PC client
- Listen to e-mail and fax messages on the phone
- Send an e-mail along with a voice message, or add a voice message to an e-mail or fax
- And in a time management breakthrough, decide how, when, and from whom to accept calls.

The "Voice Portal"

The term "Portal" is being used on an increasingly frequently basis by Internet firms such as Yahoo to describe powerful communication possibilities and, more specifically, direct links to related e-commerce providers. It is a powerful notion.

By unifying fax, e-mail, and voice messages with real-time call answer notification and outbound calling services, service providers can offer a "voice portal" through which they can access messages from any client or phone, anytime. Unlike traditional solutions, Unified Communications (UC) passes the control of communications from the sender to the recipient by consolidating voice-mail, e-mail, and fax on a single IP network independent of location, time, or device.

Unified Communications: Redefining the Nature of Communications

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Big Ten IT Graduates to Its Intranet

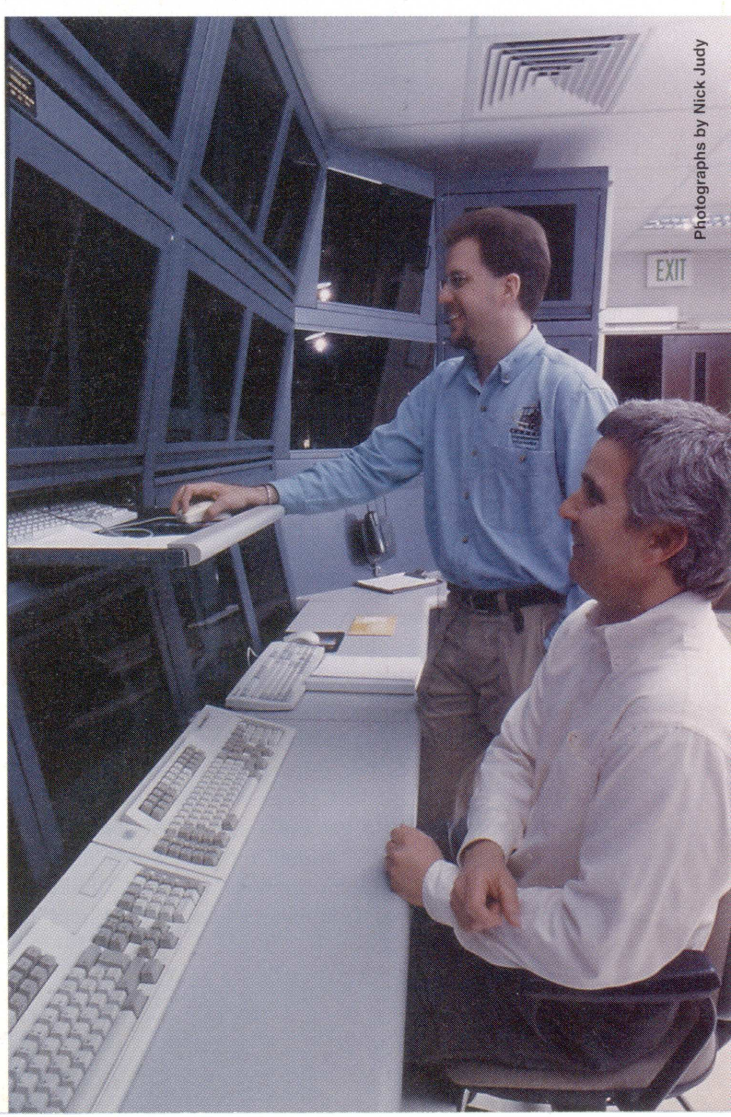
AMS Teaches the Purdue University Intranet to Stand on Its Own Two Feet

By Lawrence Brooks

Cover Story

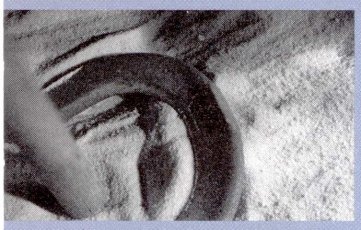
Purdue University developed the Web-centric Student Services Information system (SSINFO) so its students could find out about anything they needed to know to make their lives at the Big Ten school less hectic and more enjoyable. From financial aid awards to scholarship searches; from job postings to searching for off-campus housing; from volunteering to purchasing concert tickets; it's all there on the Web. Even if students need help with their schoolwork, they can view a list of people who are interested in tutoring. There's a lot of information that is very student-specific, but there's also a lot of general information that puts opportunity at each student's fingertips.

All this was made possible through the efforts of a talented program development staff using Cincom Smalltalk as the object-oriented technology of choice, along with Cincom VisualWorks and its Web development

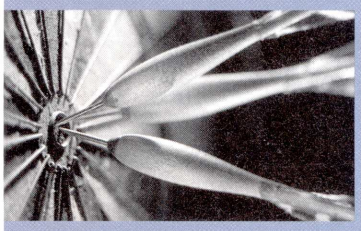


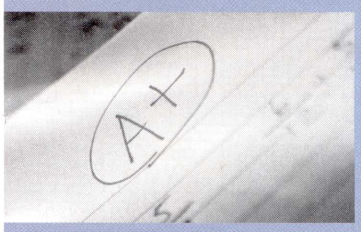
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component, VisualWave. Purdue has its VisualWorks application servers running on Windows 95 machines, with its VisualWave Web server software on NT machines. These application servers write to and retrieve information from its Oracle database on the HP-UX platform. Cincom Smalltalk simplifies packaging, support and new-version delivery, while offering a new business model to existing users of VisualWorks and ObjectStudio. Cincom Smalltalk packages together VisualWorks 5i1 main components and ObjectStudio Enterprise 6.2.

SSINFO uses the HP9000-K570 system, which includes a 100 Base T network interface card. The machine runs an HP-UX version 11.0 operating system, driving an Oracle database. The IT staff has added an additional gig of memory since implementing it, which brings the total to 2 gig. The configuration includes 2 CPUs in the machine, 30 gig of disk space and 2 gig of memory. There is a campus backbone that is used for access to the Internet. The University uses the network node manager product of OpenView and it plans to pilot the IT/O product in the very near future.

But that's SSINFO as it is today. Just how did Purdue implement such a successful student-focused system? It wasn't that long ago that it was only a long-range plan of the University's Management Information staff.

DESIGN THE SYSTEM

In 1995, Purdue started to work on a new "object-oriented" Student Services System, which was to be designed and built as a constellation of several major student administration functions. The intent was to share data and consistently apply common business rules among various functions, which included:

- Student Contact System (recruitment)
- Academic Record
- Master Schedule
- Individual Plan of Study, Academic Monitoring, Candidate Processing
- Student Registration and Scheduling
- Transfer Credit Articulation
- Admissions
- Student Billing and Payments
- Financial Aid

The Management Information staff knew that this was a major undertaking and that they were moving into a challenging technology area. They decided that they would prefer to partner with an organization experienced in this development environment.

According to the Director of Applications and Project Management Services, Nancy Yuochunas, Purdue went through an RFP process in order to find a partner. "We talked with three different companies, and selected American Management Systems (AMS), because of its expertise in this technology area, and its experience in higher education," says Yuochunas. "We partnered with them to jumpstart our development staff in the object-oriented environment, and in using the VisualWorks tool set."

Susan Gothard, the Technical Project Manager for Student Systems, adds that "one of the requirements of the partnership was the concept of knowledge transfer. The intent was for the partner to be able to eventually leave us alone, and for us to be able to stand on our own two feet."

And stand on their own two feet they did. AMS provided the initial training for the Purdue staff to learn how to use VisualWorks and VisualWave in an object-oriented, integrated development environment.

VisualWorks is a robust Smalltalk Integrated Development Environment that provides cross-platform compatibility across Windows, Macintosh and a variety of UNIX platforms (including Linux). Additionally, VisualWorks offers strong integration with the Internet, and a core engine that Purdue sees as the best performing and most stable in the Smalltalk market.

VisualWave, a key component of VisualWorks, provides a fast way to create, deliver and change interactive intranet and Internet applications. VisualWave allows the University to move their business-critical applications onto the Web, and provide a dynamic, two-way communication interface with users.

The Purdue staff became productive very quickly. They had object-oriented analysis and design training in May 1995, and by the end of June, they began interviewing different people on campus about what kind of information they would like to see in the Student Contact System. The team had six weeks of VisualWorks training and by December 1995, they began development.

The first system Purdue worked on was the Student Contact System (SCS), which handles the University's recruitment activities. Two significant schedule delays gave Purdue the luxury to devote extra time to this first system. The original implementation was scheduled for the spring of 1996, but this turned out to be totally unrealistic, because of the complexities of the data conversion, the need to produce a design that supported reusability, and the scope of the recruitment process redesign. The system was eventually scheduled for implementation in the spring of 1998. The extra time was,

Purdue's Configuration

Application Servers. Eleven VisualWorks application servers that comprise a distributed processing environment. These are 128 MB RAM, 333 MHz, Windows 95 machines.

Web Servers. Six VisualWave Web servers on Compaq NT (Model 1850R) workstations. Each server has 384 MB RAM, 450 MHz processors.

Database. Oracle database residing on an HP 9000-K570 UNIX platform. The HP 9000 has two CPUs, 30 GB of disk space and one GB of memory.



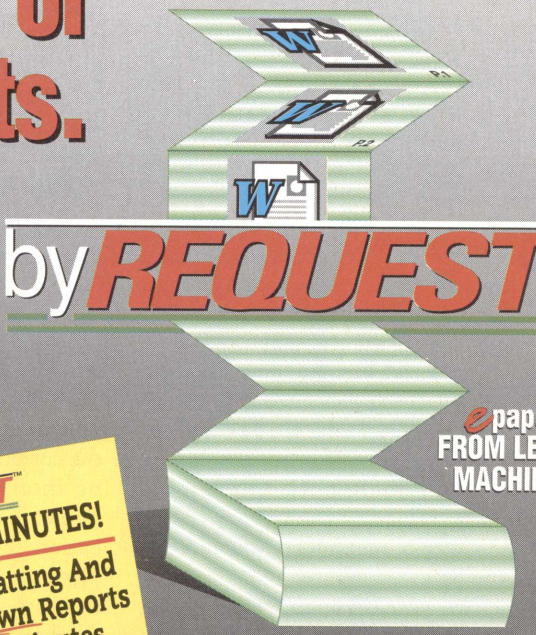
Nancy Yuochunas (center) and Laverne Knodle (right), pictured with the lead developers and architects of the SSINFO Project: (left to right) Gary Yates, Joe Faulkner and Lyle Janney, inside Purdue University's Administrative Computing Center. SSINFO resides on an HP 9000-K570 UNIX box with an Oracle database. The machine currently has 2 CPUs, 30 GIG of disk space and 1 GIG of memory.

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however, put to productive use to improve both the product (system) and establish an effective development process.

The foundation of the system was designed as a set of infrastructures that could be reused throughout all of the other student projects as they went forward. These infrastructures were identified through iterative design processes that sometimes required completely redesigning portions of the system.

As the team worked on the system, they looked for ways to organize their development activities so that they could continually improve upon performance.

And, to help the transition into new recruitment processes, the data from the existing system was converted to a reporting database in the spring of 1997, and the Admissions Office staff began developing queries to support their new activities.

Finally, to assure the quality of the data conversion, two full conversion tests were run.

The two-year delay ended up giving them an opportunity to deal with the type of performance and quality issues that you don't normally get to deal with in a system.

CREATE REUSABLE FRAMEWORKS

The SCS implementation included a significant amount of application frameworks that proved to be very useful in later development. "One of the things we can say about VisualWorks is that anything we had already built in the Recruitment System, that was applicable to use in SSINFO, was reused," comments Gothard. "We didn't have to redo anything that was already done. This is probably the biggest advantage to using VisualWorks."

These frameworks included, but were not limited to: Persistent Object Framework, Network Communications Framework, Client/Server Framework, Transaction Processing Framework, GUI Framework and a Web Framework. But one of the key frameworks developed was the Configuration Management Framework.

Configuration management has always been the bane of client/server systems. Configuration management is all about dealing with updating and configuring software that may be distributed on hundreds, perhaps thousands of computers. Purdue has completely solved this problem. Their systems are self-updating and have the ability to do realtime patches to themselves. For example, they can patch the SSINFO system to fix a problem while the system is running, resulting in zero downtime for the students.

As the team worked on the system, they looked for ways to organize their development activities so that they could continually improve upon performance.

However, Purdue takes configuration management beyond that. Every server component of the system is the exact same program. It simply configures itself differently when it starts, so it is running the correct components. It does this with no intervention from a person. This means that Purdue can add a new application server to the system simply by placing a configuration entry for it in the database and starting the server program on the machine. It will configure itself and join in the environment, possibly even picking up and helping with any processing that is currently running. This ease of configuration means that the system has built-in fault tolerance: Should any machine fail, it can easily be replaced by any other.

GET TO THE INFORMATION

Now that this portion of the Student Services System had been implemented, next came the challenge of providing students with direct electronic access to the general information and to their own specific academic information. At the time, to access information, students had to telnet in and look at a display that was similar to a 3270 emulation screen. Even worse, the system ran off a copy of the student services production database. The information was not always current, and there was no way to guarantee that the information was complete. Purdue knew it needed to invest in a student information system that could be accessed through the Internet, would share production data whenever possible and would integrate with the new Student Services System. Thus, began the design and implementation of SSINFO.

The design followed a phased implementation schedule:

Phase I. By following their general approach to system development (i.e., analysis [event based]; general design; detailed design; development; testing; and implementation), within four months, Phase I of the new SSINFO Web-based system went live (June '99). SSINFO accesses information from both the SCS database and Purdue's legacy systems. As the legacy systems are retired and moved to the new integrated database of the Student Services Systems, more information will be displayed from the new system and less from the remaining legacy systems. "I think the significance of this is that it was just the previous December when we first

See **Big Ten** *on page 40*

Inside Purdue University

Purdue has its main campus in West Lafayette, Ind., and has an enrollment of more than 60,000 students. Additional sites include regional campuses at Calumet, Fort Wayne (shared with Indiana University), Indianapolis (also shared with Indiana University and North Central), and 11 locations offering technology programs throughout the state.

A land-grant institution, Purdue first offered classes in 1874. Instruction is organized through the schools of Agriculture; Consumer and Family Sciences; Education; Engineering; Liberal Arts; Management; Pharmacy, Nursing and Health Sciences; Science; Technology; and Veterinary Medicine.



Purdue University's SSINFO Project Team at the Engineering Mall Fountain



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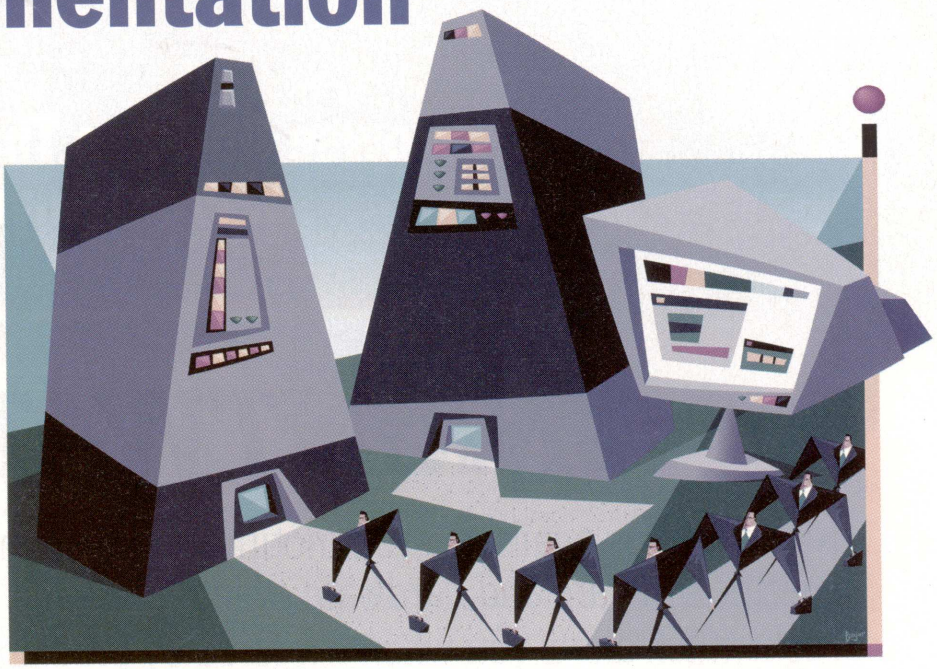
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NT Infrastructure Design and Implementation

Deploying Microsoft Cluster Server for the Enterprise

Victor Tayao



In a recent major business initiative, one of the nation's largest healthcare providers faced a daunting challenge: How to overhaul its aging computer infrastructure to handle the complexities of a national enterprise serving nine million members. With almost 70,000 workstations distributed across the United States, the company struggled with the same difficulties of other organizations its size: How to distribute and support – in a timely, cost-effective manner – the myriad applications required by its users. Moreover, the company needed to ensure continued system availability and update its failover processes to ensure high-resource availability for mission-critical applications across the enterprise.

The infrastructure upgrade contemplated by the company constituted a massive undertaking involving the design and construction of a distributed computing infrastructure based on Microsoft's NT architecture, but enabling coexistence with UNIX and NetWare platforms. Recognizing that it needed to augment its internal resources to carry out a project of this scope, the company engaged technology consulting services firm, The Axean Group, to design and architect an optimized, high-availability, scalable solution.

A MULTITUDE OF CHALLENGES

The Axean Group's overarching challenge was how to design, deploy and maintain an NT desktop and server infrastructure that supported core enterprise applications and local market initiatives, while ensuring high-resource availability and manageability of client data, and lowering overall costs. But, a series of other challenges quickly came to the forefront.

For example, the project's scope included providing centralized support for decentralized deployment, and involved large-scale, simultaneous installations and migrations from the legacy to the new environment.

A "managed" desktop – capable of providing access to enterprise applications and file and print services – was a base requirement of the project. These core service requirements expanded further still to include asset management, software distribution, name resolution, address management, quota management, Internet services, NetWare and terminal emulation gateway services (for mainframe and UNIX hosts), and backup and recovery.

In order to provide all the services outlined above, the infrastructure design would require a core set of servers. To optimize hardware usage, employ network bandwidth efficiently and ensure high availability, the core servers would have to complement each other's roles within the infrastructure. Timing was a critical factor as well. The organization's fiscal year budget constraints dictated that a server solution, once finalized, would have to be rolled out to more than 150 sites within a 90-day time period.

Cost was a primary driver as well. The Axean Group's design, once implemented, would have to result in a decrease in overall computing costs and improved system manageability and availability. Availability was measured not only in the users' desktop usage in their primary location, but across locations that users were expected to visit in a given workweek. The losses that resulted from unavailable systems far outweighed any other cost factor. These objectives, in turn, would have to be balanced with other business requirements, such as autonomy at the enterprise's various sites and centralized control.

THE SOLUTION

After completing the requirements analysis and project planning, The Axean Group developed several "proof of concept" scenarios based on an engineered approach to meet the company's requirements. It was a given that the technical effort required to

Illustration by Robert Burger

Hewlett, Packard & Forsythe.

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successfully execute the project would be significant, but its organizational aspects would demand considerable management effort as well. Therefore, validation of the proof of concept scenarios would have to include verifying the management aspects of the project, as well as the effectiveness of the system design from the standpoint of implementation and support.

The infrastructure design that was ultimately accepted by the company proved successful, and the company currently employs The Axean Group to manage the transition of its ongoing systems support and the expansion of its infrastructure into other areas of the enterprise.

The design elements include:

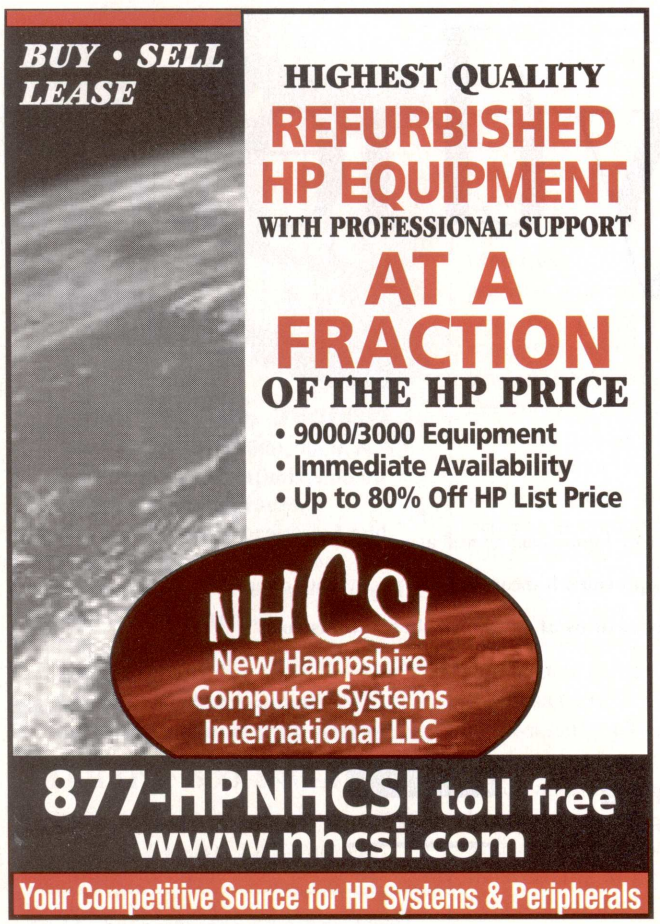
- High-availability systems, from the desktop to back office support systems
- Standard desktops across the infrastructure for ease of software distribution and remote support
- Scalable infrastructure and deployment methods
- A support model that provides centralized oversight, but allows for local market execution
- An approach for leveraging hardware vendor relationships that lowers costs while increasing availability and geographic coverage
- Effective configuration management and change control

APPLICATION	CATEGORY
Microsoft Office	Office Tools
Paradox	Database/Transitional App
WordPerfect	Office Automation/Transitional App
Harvard Graphics	Presentation/Transitional App
Visio	Graphics
Lotus Notes	Electronic Messaging
Adobe Acrobat	Document Viewer
Microsoft Internet Explorer	Web Browser
QuickTime for Windows	Multimedia
Attachmate	Host Access
McAfee VirusScan	Antivirus
Microsoft Project	Project Management
Crystal Reports	Report Generation

Table 1: Desktop Solutions

- A sustainable engineering effort that results in a predictable and supportable environment
- Proactive system monitoring and management

The above design incorporates swift procedural and automated deployments, reduced support costs and improved availability – which collectively resulted in our reaching the earlier stated goal of reducing overall operating costs.



THE APPROACH

To carry out this project, The Axean Group employed its ModelOffice Methodology, a phased-methodology designed for developing and implementing enterprise-level technology infrastructure upgrades. Every aspect of the project – from assessments of the current architecture to proof of concept scenarios, development of the engineered solutions, implementation, and ongoing support and review – followed the tenets set forth in ModelOffice.

A first step in the design process involved identifying common components – such as high-availability functionality from the desktop to the server – and developing them for reuse throughout the project. In addition, core teams (organized by geographic area) were formed to handle the project's complex organizational aspects – from design to technical training, information management, installation and deployment. Team members employed the ModelOffice Methodology in developing and validating their work product and ensuring close coordination with other teams.

Three additional project elements also contributed to its success:

- Decision-making bodies (called "governance boards") were set up at multiple levels of leadership within the enterprise. The governance boards assisted with overall project management, including local market acceptance of the project.
- Centralized project controls for finance and planning were implemented to assist with project costs and deadlines.
- Detailed "Statements of Work" – a standard ModelOffice Methodology documentation deliverable – were developed to clarify activities, costs, staffing and scheduling associated with each aspect of the project, from engineering to deployment and support.

Various factors contributed to the decision to use specific products for the project's technology solution. Technical and functional merits were balanced with cost and installed base factors. Table 1 (on page

18) and Table 2 (on page 20) show the technology solution that we arrived at, including various hardware and software components for the desktops and servers.

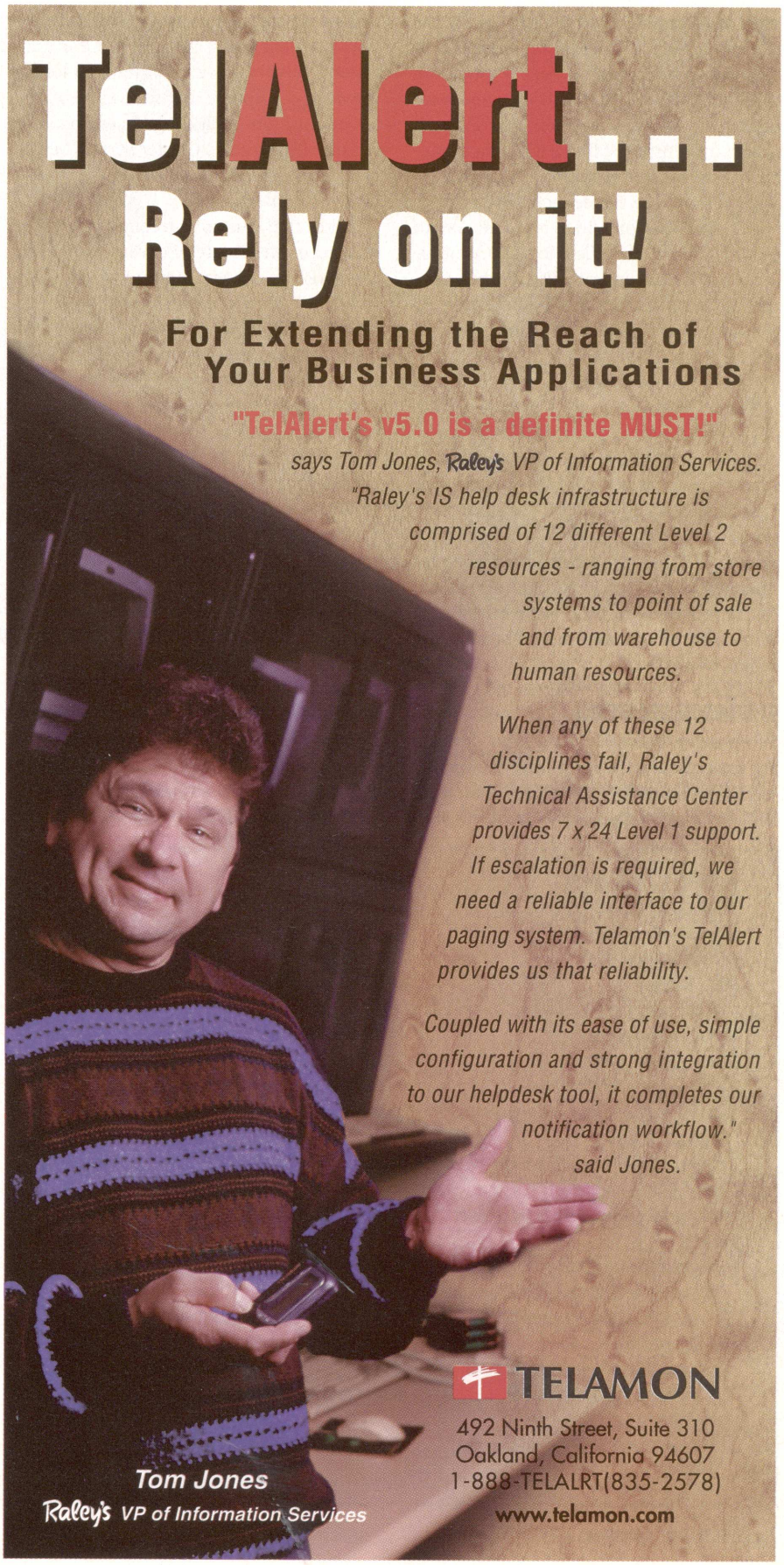
ENGINEERING, APPLICATION INTEGRATION AND DEPLOYMENT

All of the project's engineering deliverables were designed and modeled in the ModelOffice Lab prior to being moved into production. Working within the lab environment, Axean engineers developed automated build routines for each server type, as well as the standard desktop. The automated routines were designed to meet one of the most critical objectives of the project: The ability to support multiple, simultaneous deployments at more than 150 sites across a wide geographical region. To better leverage the use of vendors in the installation of hardware, the build routines had to be designed to run unattended for most, if not all, of their phases.

Working with the engineers, Axean's technical writing staff developed detailed checklists ("job aids"), procedures and planning guides designed to reduce the need for highly-skilled engineers during the deployment phase. In addition, The Axean Group provided the organization's IT staff and vendor technicians with comprehensive training on all aspects of the deployment process – from site preparation to server/desktop deployment methods to final quality assurance and production acceptance.

As with the server build engineering, applications were integrated centrally in the ModelOffice Lab and deployed according to local area needs and schedules. A combination of client- and server-based applications were deployed to support the organization's requirement for a roaming desktop. Support was likewise defined across sites using a tiered model for escalation and elevation of issues. A Web-based Support Desk tool integrated with Systems Management Server (SMS) was used to track the project's progress, as well as individual service requests and support calls.

MS Cluster Server provided a 2-node failover system that enabled 24x7 availability for file and print services. (For a complete overview of MSCS, see "The MSCS Solution.") Since user files and profiles resided on the file servers (in order to support full roaming and file recovery throughout the enterprise), the introduction of clustering technology was crucial to the success of the project. In addition, server



roles were optimized across the enterprise to provide primary and multiple secondary resources for all core services – including authentication, WINS and DNS name resolution, and asset management and software distribution using SMS. DHCP was implemented using split scopes on separate LAN segments and servers for each site.

Using tools provided by The Axean Group's EveryOffice Distributed Computing Toolkit, our engineers developed centralized login scripts and implemented policies to manage the "look and feel" of the desktop, as well as control access to applications. Our engineers also employed EOTK to create routines that, in the event of multiple system failures, would automatically locate the nearest application server and a backup machine. Core file and print services included transition support from NetWare servers, interoperability with UNIX and gateway services to the mainframe. In order to enable full roaming for notebook PCs, EOTK routines were implemented to support synchronization of notebook files.

THE MSCS SOLUTION

While down times of even a short duration are unacceptable in most large companies today, a system failure within a medical facility may constitute even greater consequence. In part due to its significant expansion in recent years, the healthcare organization's initial failover solutions no longer provided the uptime and recovery required by its mission-critical applications. The release of Microsoft's Cluster Server (MSCS) product provided the answer to the organization's problems.

Like other clustering technologies before it, Microsoft Cluster Server enables an enterprise to connect a group of servers in order to improve data availability, server manageability and performance. Even with two physical servers connected in a cluster, the workstation responds to the cluster as if it were a single server. In the event of a system failure, cluster software automatically disperses current workloads from the failed system to remaining systems in the cluster, thus restoring user access to data and services without interruption. In fact, end users are typically unaware that a failure has occurred. Hoping to improve upon clustering solutions of the past – which were often complex, difficult to configure, and relied upon expensive proprietary hardware – Microsoft is developing MSCS for its NT server-based OS, based on open specifications and industry-standard hardware.

Despite certain limitations, MS Cluster Server proved to be an excellent solution for providing core desktop services for the healthcare organization's vast network of workstations. Prior to deployment, Axean's engineering team put the product through its paces using a variety of scenarios in the ModelOffice Lab, and it performed solidly with respect to failover and failback. The product provides an excellent 2-node failover solution for NT enterprise infrastructures that require high-availability systems (see Figure 1 on page 21).

APPLICATION	CATEGORY
NTS Enterprise Edition	Operating System
MS Cluster Server	Storage Management/Failover
NT Resource Kit	OS Tool
SQL Server	Database
MS Internet Information Server	Web Server
QuotaManager	User and Group Storage Administration
Seagate Backup Exec	Storage Management
Enterprise Administrator	Security and Administration
Intel LanDesk Virus Protect for NT Server	Antivirus
Teloneas Network Management and Monitoring	Systems Management and Support
Pharos Support Desk Solution	Systems Management and Support
SNMP	Systems Management and Support
AdminConsole Network Management and Monitoring	Systems Management and Support
Compaq Insight Manager	Systems Management and Support
HP OpenView	Systems Management and Support
Systems Management Server	Software Distribution
MS Gateway Services for NetWare	NetWare Connectivity Tool
MS File and Print Services for NetWare	NetWare Connectivity Tool

Table 2: Server Solutions

TIPS FOR DEPLOYING MSCS

While MS Cluster Server represents an improvement in the high-availability arena, Microsoft's claims that MSCS is easier to configure and implement than older clustering technologies are not completely realized in release 1.0 of the product. To ensure the success of the teams responsible for installing MSCS at multiple sites, The Axean Group developed detailed procedures for dealing with the product's relatively complex hardware dependencies and software set up processes. In addition, during the project's design and modeling phase, we found it necessary to develop several tools specifically designed to address some of the current limitations of MSCS.

For example, Axean engineers developed a tool to simplify the rather complex process of configuring administrator file and print shares. Another tool tied the creation of home shares to user identification and group administration, and then integrated the entire process into Enterprise Administrator. We engineered other tools simply to expand upon the solutions provided by MSCS. Examples of supplemental tools include one that migrates existing shares (on existing servers) to the cluster configuration, another that automates the retention of file permissions, and a third tool that recreates existing print queues and definitions.

In addition to the limitations outlined above, The Axean Group also noted several areas that will hopefully be improved upon in future releases of the product. For example, the v1.0 release of MSCS provides relatively limited support for storage hardware. In addition, the applications that support MSCS are fairly limited, although it provides support for core services like IIS, file and print, and DHCP. (Ironically, MS SQL Server v6.5 was not cluster-enabled at the time of the release of MS Cluster Server v1.0.) In our tests, Oracle v7 and v8 worked well with MSCS, as did LotusNotes. It should be pointed out, though, that proper testing must be conducted prior to

deploying MS Cluster Server to ensure that all applications work well within the cluster environment. Another significant consideration involves the re-addressing of physical and virtual servers in a cluster. Changing IP addresses is not a straightforward process and currently requires reinstalling MSCS, a prospect that is untenable for existing installations. Finally, The Axean Group noted difficulties with the scalability of MSCS and intermittent problems with permissions – again, issues that we trust will be addressed in future releases of the product.

Supplemental tools developed by The Axean Group addressed limitations with Microsoft Cluster Server in the following areas: File and Print Share Configuration, Home Share and UserID Configuration, Migration of Existing Shares to the Cluster Configuration, Automatic Retention of File Permissions, Automatic Re-creation of Existing Print Queues and Definitions.

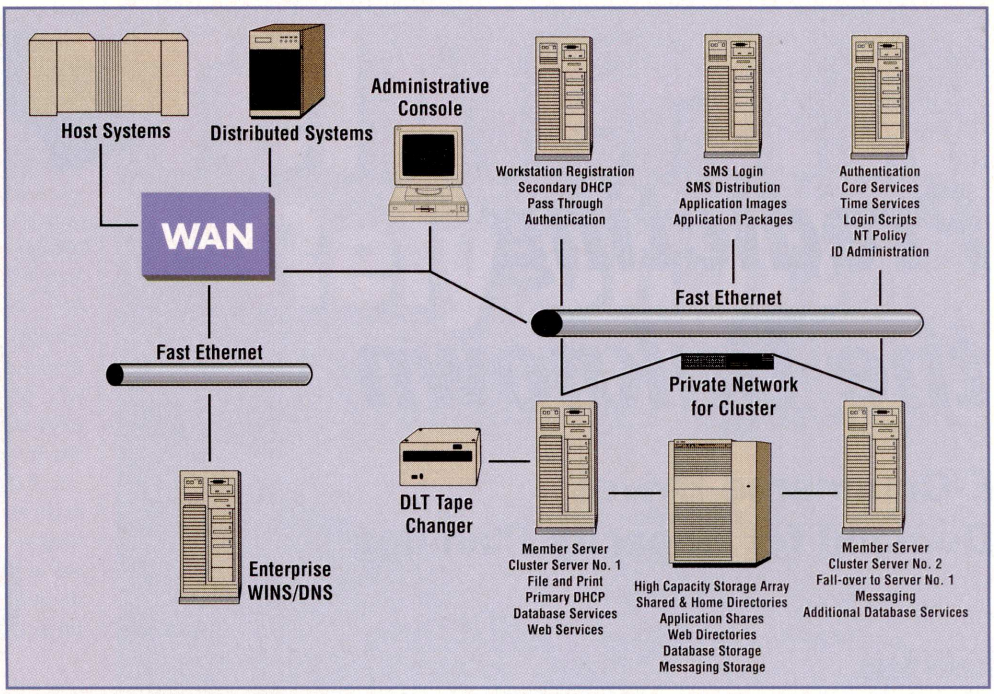


Figure 1: High Availability NT Infrastructure

HIGH AVAILABILITY FOR W2K

There are a number of alternatives to support high-availability for application servers. They include hardware-based solutions for redundancy, hot-standby, from hardware components to whole server setups. Application-based solutions include load balancing to failover solutions for specific applications or application components. In Windows 2000 (W2K), there are a number of new features, as well as enhancements from those available in Windows NT 4.0 and MS Cluster Server v1.0.

Windows 2000 high-availability solutions will ultimately be compared to UNIX-based solutions and, with W2K, the Microsoft offerings become very competitive in price and features. With W2K, scalability and high-availability features now play in the large-scale memory space.

Advanced Server supports up to 8GB of memory and SMP support for up to 8 processors. Windows 2000 Datacenter, set to be released later this year, will support up to 64MB of memory and up to 32 processors. Windows 2000 Datacenter will not only equal, but surpass most UNIX-based solutions in terms of large memory and SMP support.

Essentially, Windows 2000 offers Load Balancing and hardware-based failover using Cluster Services. Load Balancing is supported in Advanced Server by distributing requests for IP-based application services across participating servers.

For example, Web server requests are managed through an application server running W2K with Network Load Balancing. This server, in turn, identifies available Web servers, and appropriately distributes requests across the participating servers. While supported across two servers in Windows NT running Cluster Services, Advanced Server now supports this feature across 32 participating Web servers in a cluster.

For hardware failover, MS Cluster Services still only supports two-server failover, but with enhanced management features. Four-server failover will be supported in Windows 2000 Datacenter. One thing still remains – be sure to check the MS hardware compatibility list for supported hardware.

This is crucial since not all platforms for both servers and storage are supported. As with Windows NTS and any other high-availability solution, the combination must be thoroughly tested prior to deployment. Application component-based dynamic load balancing will be supported when MS ships AppCenter – which is expected to provide support for load balancing one to many COM+ components for servers participating in a cluster. With this offering, MS will have offered solutions for all tiers of application servers.

CONCLUSION

With core engineering nearing completion, the project's deployment phase was defined in approximately one month. This phase included details on scope, locations, staffing, hardware and software sourcing, vendor selection and training, and internal coordination.

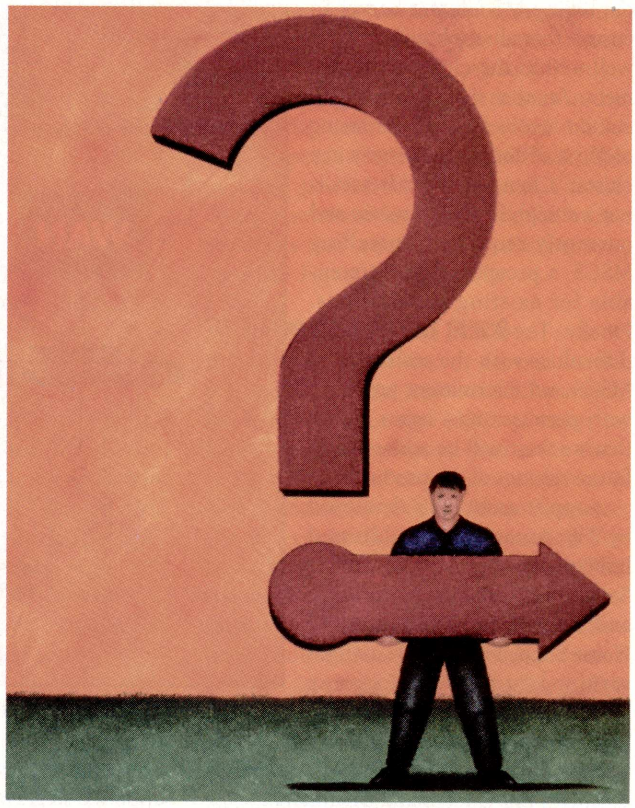
The Axean Group, utilizing a methodology (ModelOffice) specifically designed for IT infrastructure projects, effectively leveraged technology products to meet real-life business needs. The combination of technical project management, scalable processes and automated routines built from our toolkit enabled The Axean Group to respond to this project's requirements. Our success can be measured by the project's results: The actual deployment was executed in just over two months and involved rolling out 432 servers in 112 locations. Of those 400+ servers, 160 participate in a cluster – which, we believe, constitutes the largest MS Cluster installation to date in the United States. ◆



– Victor Tayao is President and founder of The Axean Group (San Francisco; www.axean.com), a technology consulting company.

Predicting the Unknown

E-Commerce Drives Demand for Capacity Planning



Rieko Sato

Application performance assessment during pre-deployment planning is an essential step for ensuring customer satisfaction, particularly in the e-business era where the financial stakes are high. The recent growth of Web-based business-to-business, business-to-consumer, and intranet applications and re-centralization trends, are driving the explosive demand for network bandwidth.

A larger pipe can alleviate network congestion and increase throughput, but it has limited effect in improving performance problems caused by latency. Capacity planning can help IT organizations right size the infrastructure the first time and reduce costly errors. An ounce of prevention goes a long way in keeping pace with the dynamic networking environment. Deferred infrastructure upgrades can result in dramatic savings over time. To take full advantage of the power of prediction, however, IT organizations must commit to strategic management of resources, instead of the reactive management that is now pervasive.

Enterprises worldwide are increasingly relying on network-intensive applications to support business processes that integrate employers, partners, suppliers and customers over the Internet. In the past, business-critical applications, such as mainframe applications over proprietary protocols, used dedicated network resources and simple growth projections for network capacity planning.

The Internet has now become the public nerve center that interconnects global users internally and externally, and transports a multitude of applications with different priorities: Web, multimedia, CRM, ERP, e-mail and legacy applications. Traffic flows are erratic and unpredictable. Business-to-business, business-to-consumer and e-business transaction paths include the extended enterprise beyond the control of IT organizations.

By opening up the network to support e-business activities, the existing IT infrastructure must support more users, transactions, applications and servers on a network that is already suffering from performance problems. Without a well-defined capacity planning methodology and tool set, network managers must resort to trial-and-error fixes if performance degradation occurs.

Strategic capacity planning delivers substantial savings by minimizing unnecessary bandwidth upgrades, and increases customer satisfaction by improving application performance. Examples of the economic advantages are:

- Reducing the cost of expensive WAN carrier services that represent a significant percentage of the network's total operating budget.
- Reducing the cost of response time problems that impact the productivity of mission-critical business processes.
- Reducing the cost of down time with sufficient capacity that accounts for growth and peak load.
- Reducing the cost of downtime with redundancy plans to address network connectivity failures.
- Reducing indirect costs associated with IT staff and consultants in trouble-shooting application performance problems during deployment.

FROM REACTIVE TO STRATEGIC

Despite these benefits, network capacity planning remains an ongoing challenge for IT organizations. In most cases, IT has taken a reactive, rather than proactive, approach for two major reasons: First, gathering the data needed to determine what applications are running on the network, who is using them, and how they are performing had been difficult. Second, corporate executives had viewed IT organizations as cost centers rather than value creation opportunities to gain competitiveness and reach new markets.

In reactive mode, IT operations would address a problem only after users complained about slow response times. Network managers would diagnose the device interfaces with a network element manager, capture network

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trace files with a portable protocol analyzer, and manually sift through the output to identify the source of the problem. This process requires technical staff with considerable expertise to yield useful information and is therefore expensive. At best, it is a time-consuming and error-prone process (see Figure 1).

Industry acceptance of distributed protocol analyzers and remote network probes made obtaining network traffic utilization statistics easier. Network performance reports automated the data collection and report generation process. As the network performance monitors improved to analyze the traffic information at all seven layers, they helped the network managers isolate and resolve problems faster. However, the mode of operations was reactive, fire-fighting problems after the fact. Network managers would learn to use the historical reports to justify infrastructure upgrades.

Network capacity planning focuses on preventing problems before they occur. Modeling and simulation tools identify network design changes that are required to improve performance levels by increasing segment bandwidth or creating shorter traffic paths to reduce round trip delay. Also, these tools can estimate the impact of new applications on existing infrastructure, helping to determine whether the new traffic load will cause performance problems.

In some cases, such exercises find that it is not new traffic that will cause problems, but the fact that the baseline network capacity has already saturated the critical point. Network capacity planning takes into account the network topology and traffic flows in predicting future capacity requirements. Linear projection of historical trends falls short of accurately predicting end-to-end performance in a dynamic networking environment.

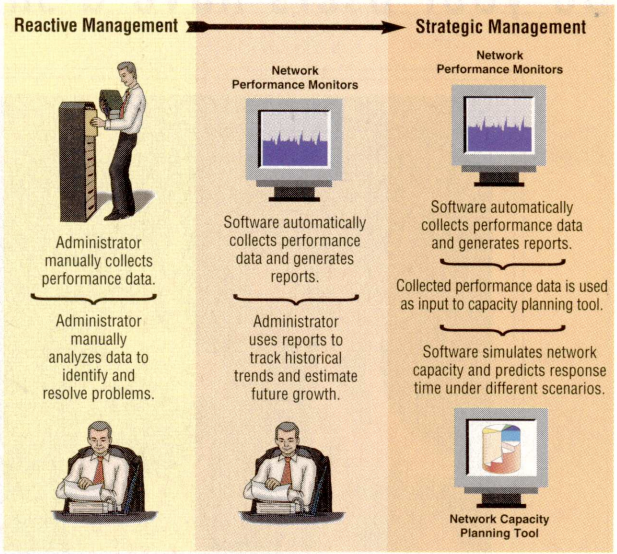


Figure 1: Evolution of Network Capacity Planning

In spite of these technical advances, the successful application of network capacity planning tools often depends on the commitment of the IT organizations to proactively manage the network. Strategic planning requires cooperation from IT network operations (to analyze the current state of the network performance), from development (to understand how new applications will use the network), and from executive management (to define the business goals and priority). This process requires proactive management of resources, which is a trade-off between available resources, cost and business demands, rather than playing catch-up.

Understanding the network impact of applications prior to deployment is becoming increasingly important as enterprises become dependent on e-business applications. Traditional companies, in addition to dotcoms, need to be concerned about the performance of Web-based business-to-business, business-to-consumer and intranet applications, under peak conditions, with the greater visibility that e-commerce brings.

Assessing network readiness by analyzing the interaction between the application and infrastructure on a transaction by transaction basis eliminates guesswork and ensures customer satisfaction by maximizing application performance. Establishing realistic service levels is an essential step in successfully managing customer expectations and proactively planning for undesirable conditions. Also, rightsizing the infrastructure allows IT organizations to control spending and get full value for the money.

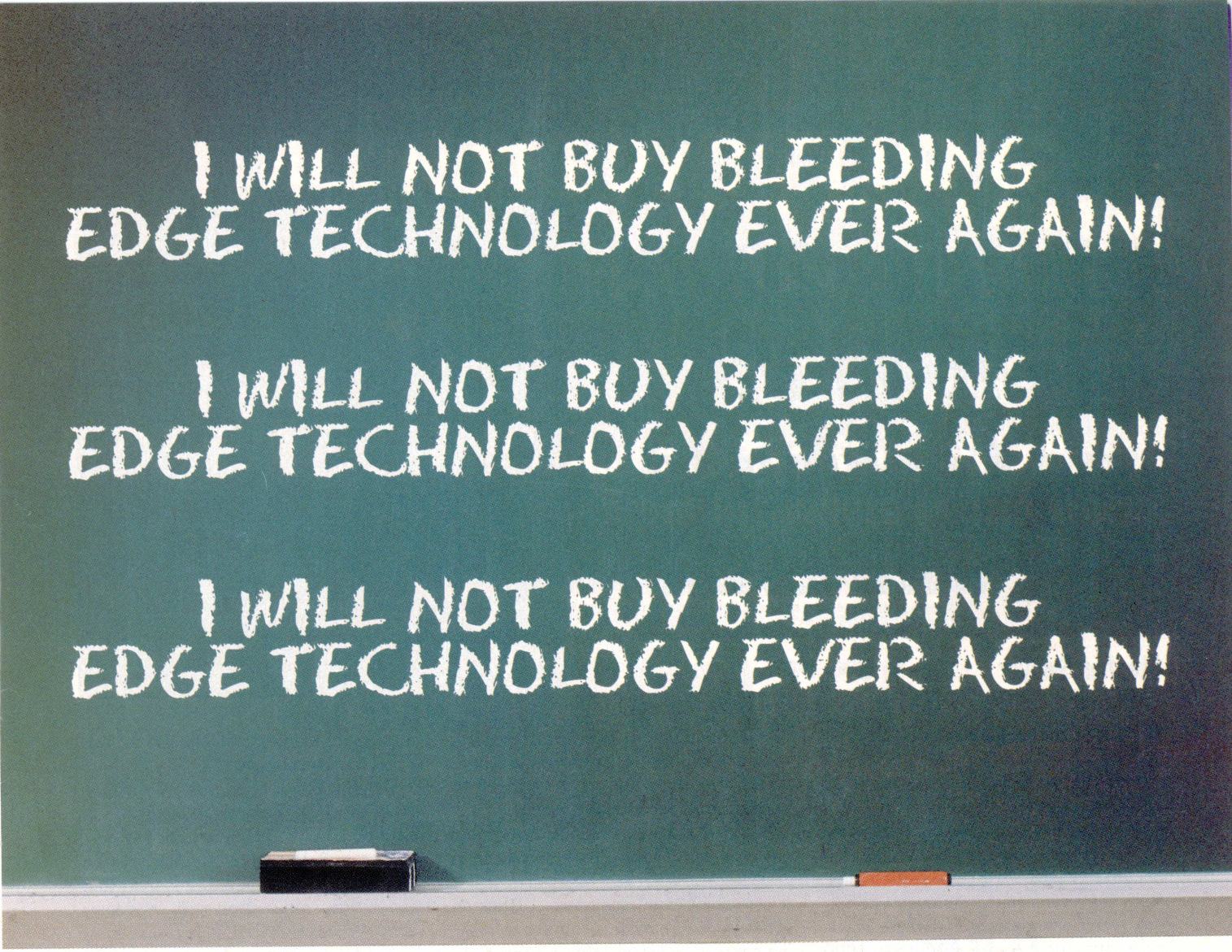
Capacity planning has become easier for network managers and network architects with tools that automate the process of populating the baseline models. Streamlining the set-up process allows for dynamic forecasting using reality-based operational data. The output from predictive analysis is used to set future alarms that alert IT operations of performance problems before they occur. Emerging capacity planning solutions integrate performance data from the application service layer that spans across the client, network and server, and manage the complete performance management life cycle.

PLAN YOUR FUTURE

Is network capacity planning worth the effort? Yes – particularly with the arrival of products that make it easier and require less time setting up the model. Capacity planning is an indispensable tool for preventing performance problems as the infrastructure needs grow at the frenetic pace of e-business. The proactive approach helps IT organizations get it right the first time and reduce costly errors, rather than the hit-or-miss, "throw hardware at the problem," reactive tactics. ◆

– Rieko Sato is Director of Network Performance Product Management at Compuware Corporation.





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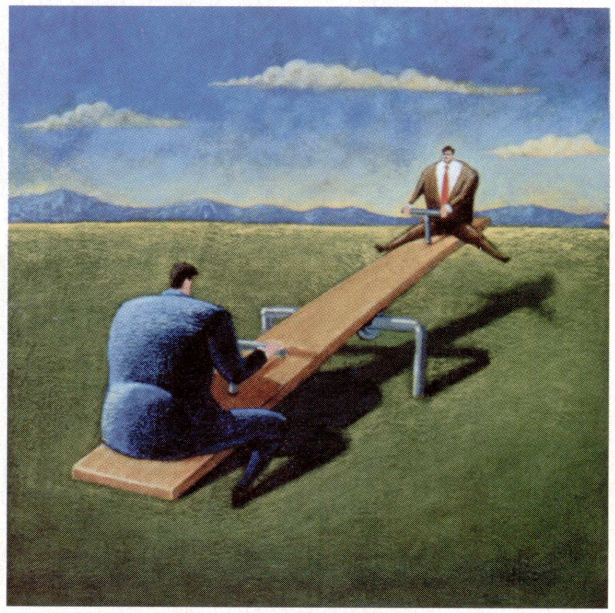
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Windows 2000: All Grown Up and Looking to Play with UNIX



Stephen Swoyer

With the introduction of its Windows 2000 operating system, Microsoft hopes to be able to compete on equal footing with the powerful UNIX servers that have traditionally dominated the enterprise computing landscape. And because it packs a host of amenities, including an integrated multiuser application server environment and a new enterprise directory service, Windows 2000 claims to have more than mere performance parity with UNIX going for it.

INTEROPERABILITY EXISTS

Of course, once Windows 2000 is actually sharing space with its more seasoned UNIX brethren, it's going to need the necessary tools to make nice with them. Not surprisingly, says Rob Enderle, Senior Analyst with Giga Information Group, Microsoft is taking interoperability with UNIX systems very seriously.

"It's a very serious issue for them, basically, because they realize that they gave UNIX its second wind by taking so long to ship Windows 2000 in the first place," Enderle explains. "Now, if Microsoft wants Windows 2000 to be accepted in the enterprise, they've got to show that it can coexist with those UNIX and Linux systems."

Surprisingly enough, it actually has a pretty good interoperability story vis-à-vis UNIX and Linux platforms. It'll need it, says Windows 2000 Group Product Manager Peter Houston, because administrators accustomed to UNIX management tools and services won't be very receptive to learning the administrative ropes on unfamiliar Windows 2000 systems.

"I believe that, ultimately, a lot more customers will take a look at Windows 2000 if we make it easier for them to deploy it with their existing systems," Houston concedes. "If you ask customers to make big jumps in order to embrace a new technology, they're less likely to do it, and certainly interoperability lets them do this. If people can use and evaluate Windows 2000 in a NetWare or UNIX environment, then, ultimately, they will pick Windows 2000."

In April, the software giant shipped its Windows 2000 Services for UNIX, a set of tools and utilities that include a Network File System (NFS) client, NFS server and NFS gateway software components. NFS defines a file sharing standard for UNIX systems that was originally developed by Sun and is currently leveraged by most UNIX vendors as a means to share files between systems. Its closest corollary in the Windows world is Microsoft's own server message block (SMB) protocol, which defines a file-sharing standard among Windows systems.

Moreover, Windows 2000 Services for UNIX facilitates the native integration of several of the more popular UNIX shell environments on Windows 2000 systems. Still further, Windows 2000 Services for UNIX supports at least 60 UNIX commands and utilities, and will also include a Perl implementation.

The kicker in Microsoft's Windows-2000-to-UNIX interoperability efforts is undoubtedly the software giant's release of version 2.2 of its Interix platform – a full-blown UNIX operating system that can run in conjunction with Windows 2000 – which provides support for almost 2,000 UNIX APIs and more than 300 UNIX utilities.

The end result, claims Microsoft's Houston, is that because of Microsoft's interoperability initiatives, UNIX and Linux administrators should even be able to administer their UNIX systems from Windows 2000.

"If you're an administrator who understands how to use the shell and these commands on UNIX, then you can go to Windows 2000 and administer the system using these same commands," he concludes.

INTEROPERABILITY CONCERNS

But Windows 2000 also includes its fair share of interoperability curveballs, especially in the areas of UNIX and Linux integration. Windows 2000's new Kerberos-based security model, for example, is a proprietary one, differing in no small way from the open Kerberos standard that was originally developed at the Massachusetts Institute of Technology.

"Basically, Microsoft overloaded an application-specific field that is a maxi-

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mum of 64 KB long with a user profile, which exceeds this maximum," explains Luke Kenneth Casson Leighton, a programmer at Internet Security Service's export research services, and a member of the Samba development effort. As Leighton tells it, Microsoft could just as easily have implemented its own proprietary protocol without "hijacking" the open Kerberos standard.

"It's not reasonable at all, they could have used their own proprietary protocol to obtain their own information, and there's absolutely no technical reason to do what they did," he maintains.

As a result, Leighton points out, standard UNIX and Linux Kerberos clients will not be able to interoperate with Microsoft's Windows 2000 Kerberos implementation.

And then there's the question of whether the Samba Team's Samba client will ever interoperate effectively with Windows 2000 and Active Directory. Samba – an open source SMB implementation that runs on most UNIX and Linux platforms – works right now with Windows 2000 in NT 4.0 backward-compatibility mode, Leighton says, but probably won't be able to interoperate with Active Directory-enabled Windows 2000 systems for quite some time – if ever.

"If people want Samba to be compatible with an NT 5-only [Active Directory] domain, they'll have to tell us, because if they don't start asking for it, we won't bother," Leighton concludes, noting that NT 4.0 interoperability is foremost on the Samba Team's list of priorities.

HP & WINDOWS 2000

While former UNIX stalwarts, such as HP, have seen their stakes in the UNIX high-end and midrange server markets erode to a great extent, Sun Microsystems has boasted impressive growth in both spaces, enjoying 19.2 percent overall growth in shipments of its Solaris operating system in 1999, according to IDC.

The bottom line, says Giga's Enderle, is that Sun's position of defiance vis-à-vis Windows NT/2000 adoption has served to enhance rather than hurt its overall position among UNIX vendors and in the UNIX community as a whole.

"Sun is dominating in the UNIX market, and through its marketing and overall strategy has succeeded in positioning HP as either diluting UNIX or not being fully committed to UNIX because they both also have a Windows NT/2000 strategy," Enderle says.

But as Giga's Enderle points out, Sun's anti-Windows posturing creates opportunities for vendors with mixed UNIX and Windows NT strategies, such as HP, which can attempt to out-market Sun by providing "blended" solutions to serve the needs of customers on both the low and high ends of the enterprise spectrum.

"HP has a strategy, as does IBM, as do other players with multiple platforms, to compete against Sun, which has staked a claim as the only UNIX-only provider," Enderle says. "So to compete against Sun, HP and IBM have to offer something that Sun can't offer, and that is a blended solution. So, whether it's Linux or the Microsoft Windows products, both can give you the benefits of UNIX at the high end until these products perform at the high end, so their value proposition is a thorough blend."

To compete against Sun, HP has to offer something that Sun can't ... a blended solution.

As part of its mixed UNIX and Windows strategy, HP is slated to release a software product – dubbed the Common Internet File System (CIFS/9000) for HP-UX 11 – that facilitates end-to-end UNIX and Windows system interoperability across intranets and the Internet. HP's CIFS/9000 is actually a counterpart to Microsoft's own Common Internet File System (CFS), which is a standard for remote file access that is leveraged in all of Microsoft's 32-bit Windows platforms.

With CIFS/9000 client and server software in place, both Windows and HP-UX 11 platforms can function as file servers for one another. Additionally, CIFS/9000 solves the authentication barrier that currently exists between the two systems, providing a single-user ID and password for client authentication in UNIX and Windows system environments. HP may make CIFS/9000 available for all UNIX platforms, as well.

MULTIUSER TO THE MAX

One of the traditional knocks against Windows NT has been its lack of a multiuser terminal environment similar to that found on all UNIX platforms. When Microsoft reached an agreement with Citrix in April 1997 for the rights to Citrix' multiuser-for-Windows NT kernel extensions, it took a significant step toward addressing this shortcoming.

But, it wasn't until Microsoft incorporated Windows Terminal Services into its vanilla Windows 2000 Server and Windows 2000 Advanced Server products that its next-generation operating systems finally came into their own. With a robust multiuser environment – and a slew of purported reliability and scalability enhancements – integrated under its hood, Microsoft is betting that Windows 2000 could become a potentially popular platform choice for use as an enterprise-wide application server.

Public Host, a Web site and e-mail hosting start-up, is one organization that has deployed Windows 2000 in such a capacity. As Public Host CEO Dave Williams explains, his company – launched unofficially in May 1999 – wanted to build a reliable, scalable hosting environment from scratch. Public Host chose Windows 2000, Williams says, because it believes that Microsoft's next-generation OS offers the best overall platform for hosting of any ilk.

ENHANCED MANAGEMENT

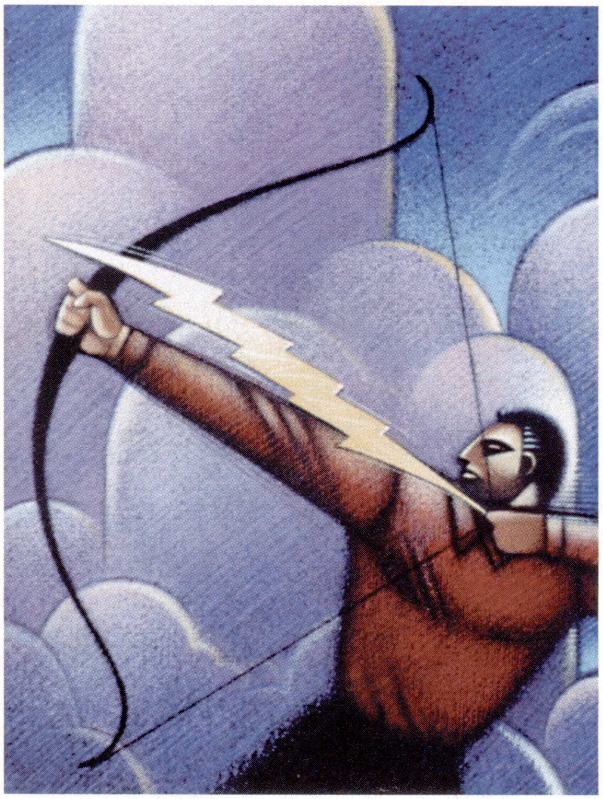
Windows NT 4.0's existing domain infrastructure is notoriously complex, and beginning with Windows 2000, Microsoft is shipping its first-generation Active Directory enterprise directory services. In addition to simplifying management in the Windows 2000 world, Active Directory should also open the way for directory-enabled applications that can enhance collaboration among users, and pave the way for advanced, directory-aware e-commerce solutions.

For its part, Active Directory is an advanced, hierarchical directory service that provides the administrative underpinning for Microsoft's Windows 2000 OS. Active Directory maintains a database of information about the network resources scattered throughout an enterprise, and can manage users, groups, servers, printers and entire networks as objects with distinct or inheritable permissions. ◆

– Stephen Swoyer is a freelance journalist based in State College, Pa., who specializes in UNIX and NT (2000) issues. He can be reached at swoyerse@yahoo.com.


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HP OpenView Sets Sights on E-Commerce



Jean Nattkemper

The technology of the new electronic world may be propelling a booming economy, driving a sizzling, if volatile, stock market, and changing everything – from the way businesses collaborate, to the way we order pizza – but it's also been giving IT managers a headache, especially in the area of system management.

The major players in the system management arena developed their software suites to align with IT department organizations divided along technology lines – a network management team, a systems management group, a storage management administrator and so on. There was relatively little overlap among these groups, and the system management vendors usually developed tools independently to solve specific management issues faced by a particular group. But, all that has changed in the new e-world.

Applications, and the services built on them, cross boundaries, and IT organizations must be able to manage a service from the back end to the end user, including external users. That means IT managers need solutions that integrate management functions and portray the entire service environment.

Last year, the large vendors – HP, Tivoli and Computer Associates (CA) – took steps to enhance their management suites so IT managers could effectively control extranets and e-commerce sites. Then, in February, HP, the predominant player in the system management space, rolled out a revamped and extended HP OpenView suite designed to give IT managers a view of the entire service environment.

The revamped system management suite, now rebranded HP OpenView VantagePoint, fulfills two purposes, according to John Peters, Marketing Manager for HP OpenView. The first is consolidation. "We've consolidated various availability and performance management products under the VantagePoint name. So IT/Operations [now VantagePoint Operations], PerfView, MeasureWare, Service Reporter and Web Transaction Observer all become part of VantagePoint," Peters says. "Second, we've added new capabilities as part of the VantagePoint rebranding, because we had to focus on key transitions in the customer environment. There's a lot more interest in driving the IT infrastructure and IT applications from a business, rather than a technology, perspective. Electronic business initiatives have changed conditions for our customers, forcing us to introduce new approaches to IT."

HP OpenView VantagePoint reflects HP's three main goals in allowing IT managers to focus on business, rather than just technical results. "First, we've moved away from the silo approach of the past – silos built on particular technologies," Peters explains. "We've provided integration to talk across silos, although, of course, we still need technical experts who are specialists in databases, Windows NT, UNIX, and what have you. But we're allowing IT managers to better align processes and functions with what they're trying to achieve in the business."

Second, HP is better meeting IT managers' need for rapid deployment and adaptability of management solutions. "E-business is thrusting new processes, new applications into the system very rapidly because IT is being measured by business results," Peters says. "IT has to build in new applications very rapidly in order to compete. The speed with which they can adapt new technologies is a key factor in managing these technologies. So, it's important that we provide for speedy implementation of manageability, as well as for speedy implementation of new solutions."

Finally, Peters says VantagePoint addresses the issue of the lack of skilled IT professionals. "With VantagePoint, we help to reduce the skills required in IT management by automating processes."

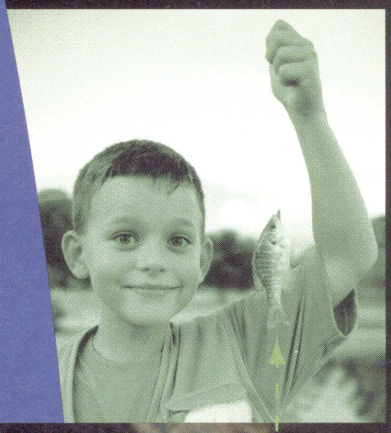
INTELLIGENCE MANAGEMENT

HP OpenView Vantage Point manages business services through three types of intelligence: business-driven intelligence, instant intelligence and active intelligence.

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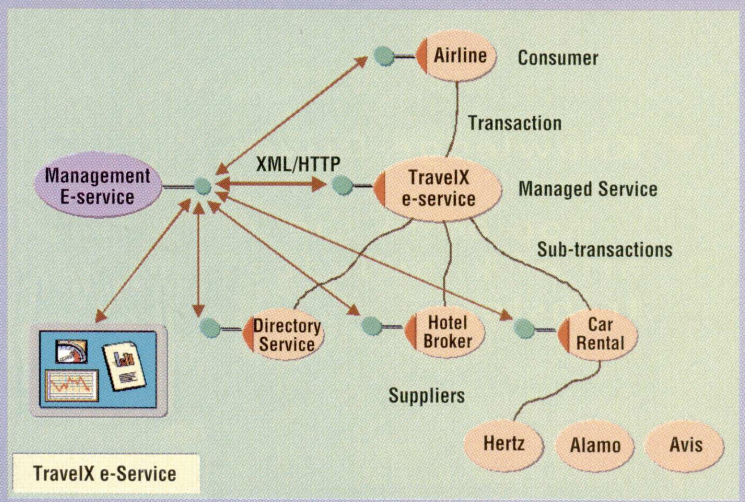
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Integrating HP OpenView with e-speak

It's not surprising that HP chose OpenView as the first enterprise management solution to be embedded in e-speak, the new technology helping to drive HP's e-services strategy. e-speak, which consists of five components – dynamic discovery, service composition, negotiation, contracting, and mediation – allows services to come together dynamically to achieve the end a user desires, without human intervention.

HP now boasts a demo in which it has successfully implemented about 60 percent of OpenView's features in e-speak. The demo runs so well, reports Dave Lewis of HP's e-speak operation, that it operates on a 24x7 basis and has been brought down only when HP engineers wanted to make additions.



e-speak Ecosystem with OpenView Generating Report: The e-speak ecosystem is composed of the TravelX engine, the hotel engine, the rental car engine (with rental car services feeding into the rental car engine), and the directory engine.

The demo features an e-speak ecosystem handling travel mediation for a major U.S. airline. This ecosystem is constantly receiving transactions from a TestDriver application and delivering services. The second piece of the demo features an OpenView interface that reports statistics – for example, usage rates and SLA violations – on what is taking place within the ecosystem.

This e-speak enabled ecosystem solves a major problem for airlines dealing with stranded passengers. It provides services now generated only through manual processes. The ecosystem allows the airline to dynamically discover, compose, negotiate, contract and mediate a solution for each passenger on a canceled flight, based on the needs of the individual. Moreover, this customized one-to-one solution can be delivered to hundreds of people in a very short time. OpenView plays its role in all this by reporting on that take place as the TestDriver moves transactions through the ecosystem. ***– J.N.***

Business-driven intelligence is rooted in HP OpenView's Service Navigator technology, first developed to provide a visualization mechanism for IT services managed by OpenView IT/Operations. With VantagePoint, this capability has been transformed to provide a top-to-bottom view that addresses immediate business perspectives rather than infrastructure and server issues. Business-driven intelligence provides business-centric views of critical services; shows the business impact by relating business processes to services and their underlying network, systems and application elements; and measures IT performance in terms of business service objectives and bottom-line results.

With service views, IT managers can visualize how IT resources work together to deliver business services, as well as clarify the bigger picture or focus on a particular managed object. The views show network elements, computer systems, databases and the application itself so that IT can identify the components that make up a particular service. If a component fails, then, it is clear which services are at risk. IT managers can modify service views via a graphical configuration tool. The views are dynamically updated on-screen as the underlying management model changes so there is an ongoing, realtime, virtual representation of the business service. VantagePoint Reporter supports the service-level model by providing standard and customizable reports showing IT service quality levels (application response times and service availability) from aggregated event and performance data to provide reports on service delivery performance.

VantagePoint's instant intelligence makes use of an auto-discovery mechanism to discover and manage services in the electronic environment. Information obtained through auto-discovery is used to populate the management model repository. Management models capture and maintain all elements of an end-to-end business service, including the hierarchy, dependencies and relationships between elements, as well as the business rules and service-level information contained within IT processes. Management models learn and adapt based on prior management experience, and adjust automatically and dynamically as components of a business service are added, removed and changed.

The VantagePoint service broker works in tandem with management model policies to prescribe the agent services to be deployed to a managed object. The types of policies enacted on the managed node are not "one-size-fits-all," but depend on what is prescribed by the policy. If, for example, management of an Oracle database is limited to the collection of historical performance information, only measurement agent services are deployed, not services that control thresholding, events and actions. VantagePoint also offers prepackaged management models, or Smart Plug-Ins (SPIs). These include second-generation SPIs, as well as new SPIs for Windows 2000/NT, Microsoft SQL Server, BroadVision and VantagePoint self-management. Users also are able to develop their own SPIs.

Active Intelligence provides an automated response to unanticipated changes and problems in the IT environment, triggered via a performance threshold. Active Intelligence continues to deploy a set of health metrics until the problem is analyzed and corrected.

The active intelligence approach works like this: When first deployed, VantagePoint collects defined service-level statistics, such as response times on key transactions, service uptime, and so on, as well as key IT infrastructure metrics, like CPU load and I/O rates, on distributed managed objects. Through the measurement engine, the frequency and intensity of data collection can be altered based on the status of the managed service. IT managers can view problems, in context, to connect the problem with a higher level service. Fixes, in the form of scripts or other applications, can be automatically executed or operator-initiated on a remote node.

All three types of intelligence are compliant with the CIMM (Common Information Management Model) and WM (Microsoft Management Interface) specifications.

HP OpenView Products

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Agilent NetMetrix Service Simulator
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Customer Views for NNM (Network Node Manager)
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Extensible SNMP Agent
GlancePlus and GlancePlus Pak
HP Dazel Output Management Solutions
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MeasureWare (now VantagePoint Performance)
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SMART Plug-Ins for Exchange
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VantagePoint
VantagePoint Database Pak 2000
VantagePoint Operations
VantagePoint Performance (PerfView and MeasureWare)
VantagePoint Reporter (Service Reporter)
VantagePoint Response Time Workbench
VantagePoint SMART Plug-Ins
VantagePoint Web Transaction Observer

SOLUTIONS FOR SERVICE PROVIDERS

In revamping OpenView, HP didn't forget its 19 million ISP customers who use the management software. Following its announcement of OpenView VantagePoint, HP unveiled OpenView Venture Solutions, which enable service providers to offer Web-based delivery of management and business information to their customers.

"What service providers offer – bandwidth access and pure network access – are becoming commodities," says Tom Major, Service Provider General Manager for HP OpenView. "Service providers have to move up and sell more value-added services if they want to increase their revenue and differentiate themselves in the marketplace.

"With HP OpenView Venture Solutions, we're providing solutions based on software that enables service providers to offer new services," Major adds. "OpenView Venture gives the screen back to the end user – the service provider's customer – so that users now can look into the environment the service provider is delivering them."

HP OpenView Venture Solutions include OpenView Venture Foundation, OpenView Venture Networks, and OpenView Venture Customer Experience. Venture Foundation allows service providers to give their customers a secure, personalized interface to account status and services information. An interactive communication link between the service provider and the end customer gives the provider a means of enhancing customer satisfaction.

OpenView Venture Networks enables service providers to create customized Web-based views for each customer or group of customers, with network information that includes topology maps, events, performance summaries and network health, augmented with messages and other customer information.

OpenView Venture Customer Experience modules will enable service providers to provide visibility to the performance of hosted Web services. Customers will be able to view the actual end user access trends and performance of their e-services infrastructure. HP plans to partner with vendors like WebTrends and BEA Systems to provide modules, and, in early May, introduced a module developed with Keynote Systems, a provider of Web site performance measurement and diagnostic services.

HP is integrating OpenView VantagePoint with Keynote Perspective to allow users to view Keynote measurement data in OpenView's user interface. Through predefined reports, users will be able to view, side-by-side on a single console, data collected by Perspective, which measures the realtime end user experience, with the actual IT infrastructure performance transaction times collected by OpenView VantagePoint Web Transaction Observer. Moreover, if a user's IT infrastructure is identified as the bottleneck, users can associate Perspective data with IT infrastructure performance data collected by OpenView, to quickly identify performance problems.

SOLUTIONS FOR IT PROVIDERS

HP is also targeting a particular group of providers – IT service providers – with its recently unveiled OpenView VantagePoint Internet Services. These solutions aim to enable IT service providers to obtain more revenue by selling Internet service management, improve customer loyalty through "peak demand" management, and implement cost-efficient financial administration through subscriber usage.

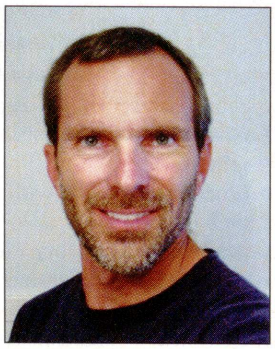
See **OpenView** *on page 35*

System Configuration Repository

About the only things in life that are actually free are those things that we don't want. At least that is how I felt before the Interworks 2000 conference for HP-UX system administrators in early April.

It seems that every year we are told of some new administration product the people in Fort Collins have developed or improved. I am always shocked to hear that it is being given away free. This year was no exception; instead, it was a bonus year. There were several system administration-related products being demonstrated, and HP is giving most of them away free.

This column is about the System Configuration Repository (SCR) product, so at least you know what you are missing, if you have not discovered it yet. SCR is both a database query system and a data collection system. The data it is designed to collect is system configuration information.



Fred Mallett
frederm@famece.com

A couple years ago, I wrote about the great command print_manifest, which is part of the Ignite/UX product. That command lists out all sorts of information about a system, from hardware to disk configuration and network configuration information. If you are familiar with that command, you have a good idea about what data SCR stores about a managed host, but there is more. Also, it can contain usage and contact data, installed software, processes running, and even patches in HP-UX 11.

Generally speaking, it is probably capable of capturing more information that you might want, but then, that is better than too little when something goes wrong (if you have the disk space to store it, and network bandwidth to collect it). Each time information about a host is captured, this data is stored in what is called a snapshot. You can then compare snapshots over time to see what has changed, thus making it easier to determine the cause of a problem.

Let's look at possible uses of SCR before we look into the general steps of using it. Knowing that we can compare system configurations over time, means that we might be able to use it for troubleshooting when something goes wrong. This might be after someone has changed the configuration of a piece of software, added a patch that broke something, or maybe some hardware has broken, such as a memory card dropping out. Using SCR to report on differences in configuration from a known good snapshot might make this troubleshooting process faster.

Another good use would be to ensure what is supposed to be a group of similarly configured machines are uniform. Comparing snapshots should show only host and network differences, with identical disk layout, LVM, memory, software, processes and patches. The use that you hope to never need would be disaster recovery. This means that you have been backing up the repository information, and storing it off site. Having this information would aid in rebuilding the lost machines exactly as they were.

On to how the software works. SCR is a Desktop Management Interface (DMI) application. This means that DMI (another free product from HP) must be installed and configured on any machine you want to capture information about. DMI provides the APIs that SCR calls to collect the data. You also need to install and configure DMI and SCR on the machine that you will be using to monitor the configurations of the "managed" nodes. It is called the Central Management System (CMS) in the documentation.

To get data collection started, you should first configure the probes. This is done by editing a filter file which determines what data to collect. This filter file is created with the following commands on the CMS:

```
scrfilter -o Probe  probefile
```

You can then edit the filter file (named probefile in the example above) as desired, look at the documentation for how to edit the file.

Next, reinstall the edited probe filter file:

```
scrfilter -i Probe  probefile
```

Now you can tell SCR which hosts to monitor (they must already have DMI installed and configured):

```
scrconfig -n  +swift  +puxy
```

At this point, SCR will be ready to monitor the two hosts listed above (swift and puxy), but will only do so when told. To tell SCR to perform probes of the configured hosts, issue:

```
scrupdate -a
```

You can then use the scrviewer command to see what data was collected. There is a good chance you want the process of collecting information automatic. This is done with the scrconfig command. The following command would make SCR perform an update of all configured nodes at an interval of once per week:

```
scrconfig -i  1w
```

Note that is "one w," not "ell w," you can specify any interval, using different options.

Once everything is setup and running,

OpenView

Continued from page 33

The HP OpenView VantagePoint Internet Services provide a Web-basedservice dashboard with a cohesive view of the service provider's customers, Internet services, and support physical infrastructure. This gives account managers an instantaneous picture of service level compliance and allows the operations staff to isolate potential problems, assess impact, and forewarn customers. Services being managed include Web, secure Web, mail, news, naming (DNS), authentication, directory and firewall services. Health summaries of these services are based on information from active software probes, which gather performance statistics from different points in the network.

The first release of VantagePoint Internet Services will support an NT-based measurement server and NT probes, and will be followed by a second release that will provide HP-UX and Solaris support for both the probes and the database on the measurement server.

HP has also announced it is integrating HP WebQoS with Vantage Point to give IT service providers the ability to assure SLAs even under extreme loading conditions and create differentiated offerings by configuring multiple classes of services for users and applications. The WebQoS and HP OpenView integration will be delivered in two phases. The first phase will include integration with VantagePoint Operations, VantagePoint Performance, and VantagePoint Reporter. The second will include integration with HP OpenView Web Transaction Observer and HP OpenView PolicyXpert.

On the service usage metering front, HP also announced integration of its SMART Internet Usage solution with OpenView to give IT service providers single management station access to both network management and usage information. The integration allows capacity planners to correlate resource consumption with patterns of usage for the same traffic in order to optimize the network configuration. Network performance can then be easily traced back to the user, or users, causing the bottleneck. ◆

– Jean Nattkemper is the Editor at Large for HP Professional. She can be reached at jnattkemper@hppro.com.



HP-UX

Continued from page 34

you should periodically check to see if anything has changed on any managed hosts. The command scrstatus will list out a record of snapshots taken, and if they were successful. Something to keep in mind about SCR is that it does not save a snapshot if there are no changes since the last saved snapshot. This is to save disk space (remember that if your probe filter looks at things like processes running, or free disk space, a probe will always be saved). To see if snapshots of a system contain any changes, use the scrhist command. This command will list out all snapshots of a system. The oldest and latest snapshot are given exactly those as names. If there is more than one, there was some change in the configuration. You can then use the scrdiff command to see what has changed. For example:

```
scrdiff puxy:oldest puxy:latest
```

If you are using the identical, dataless client network model, you might be able to save just one snapshot of a "golden" system, and compare the current snapshot of a host with the "golden" snapshot. You could use the scrtag command to name a snapshot as the "golden" snapshot.

For other types of usage, for example, active troubleshooting, you can also tell SCR to take a current snapshot of a particular system, then compare it with what you have saved for that host or a similar configuration. The scrfilter command can also be used to install display filters for the scrdiff and scrviewer commands so that you don't get flooded with information if you are only looking at one area, like software. I think that SCR would be rather handy for active troubleshooting even if you don't have SCR configured to monitor a host. Just install DMI, configure it, then compare snapshots of software installed on two hosts, if, for example, one is experiencing problems with a product, and another is note.

As a final point, it occurs to me that you might want to know where to get DMI and SCR so you can start using this great free stuff, or at least look at the formal documentation to learn more. It is available for 10.20 and newer versions. It is found on newer Application Release CDs, or at www.software.hp.com/products/DMI. The latest version was released in March 2000. ◆

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Lotsa Links

I'm not a Web junkie. Who has time to surf? Until we really have automatic agents and psychic search engines, the Web will continue to be a tangled mess. So, in the interest of

helping out my loyal readers, I've hand-picked some of the best sites for system administrators from my favorites list.

WINDOWS

LabMice (www.labmice.net) sorts links to relevant articles on the Web by categories, such as Active Directory, performance tuning and troubleshooting (a good starting point for research).

15 Seconds (www.15seconds.com) is an amazing resource for Active Server Page developers. Lots of source code, discussion, quality answers to questions, minimal advertising and a solid search feature make this site a must for new and experienced ASP developers. It's also worth it for tips on running Internet Information Server.

The Microsoft Support Knowledge Base (http://support.microsoft.com) is the search engine for all things MS. It's a quick and easy way to get to tech support information.

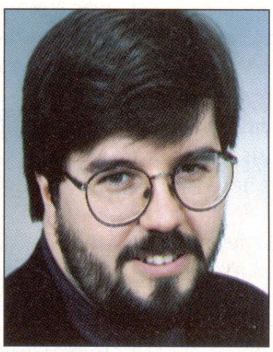
TechNet (www.microsoft.com/technet) is the online version of Microsoft's support CD package. TechNet offers white papers, lists of top support issues, case studies and lots of other detailed technical info.

Two other interesting sites are *Fix Windows Troubleshooting* guides (www.fixwindows.com); and *NT Help* (www.nthelp.com).

LINUX

The Linux Online Support Center (www.linux.org/help) supplies useful links to how-tos, documentation sites, Usenet groups, FAQs and support sites. While *Linux Online* is really the official Linux site, the Support Center is the most useful with high content and low rhetoric.

Freshmeat (http://freshmeat.net) is updated daily with the latest packages and releases. It's a quick way to find the Linux software you need with a minimum of the rabid "up with Linux" propaganda on many sites. Users can post comments about the applications and a chat room called the "lounge" features a high degree of technical talk.



Ryan Maley
ryan@maley.org

Linux Administration Made Easy (www.linuxninja.com/linux-admin/index.php3), a.k.a. LAME, is a great site for new Linux system admins. It covers all the basics, such as installation, backup, account management, and starting and stopping processes. Anyone new to UNIX will find this site useful.

Portico (http://portico.org) is a simple site which provides Linux and other UNIX tips. By tips, I mean paragraph-long hints and technical tricks on nearly any subject. The site can randomly display tips from a database or you can search on a particular topic.

Other sites are *Linux Hardware* (www.linuxhardware.net), device drivers and hardware advice; *Destination Linux* (www.destinationlinux.com), a good portal site; and *LinuxHQ* (www.linuxhq.com), for both stable and unstable kernels.

SECURITY

CERT (www.cert.org) is a great stop for the latest information on virii and known security holes on many operating systems. Funded by the Department of Defense and other federal agencies, their mandate is to keep everyone informed about security threats.

Linux Security (www.linuxsecurity.com) is the place to go for both warnings about the latest holes and security primer information.

NT Security (www.ntsecurity.net) is the one-stop shop for Windows-based security issues. The site offers the latest Windows-related warnings (usually virus related) and detailed, technical, original content on topics, such as securing your NT server and combating denial of service attacks. The site also hosts several discussion forums of very high quality and sponsors an e-mail list that will warn of the latest security threats.

2600 Magazine (www.2600.com), "The Hacker Quarterly," is devoted to the exploits of those who want to break into computers and phone systems. This is an excellent site, which is probably the voice for the hacker culture.

University of California at Davis archives a large number of very technical security-related papers at http://seclab.cs.ucdavis.edu/papers.html. The site holds academic research and results and is targeted to an academic audience. While most of the information here is abstract and not related to a particular platform, it is very interesting reading on the theories and concepts of security.

Other interesting security sites are *Technotronic* (www.technotronic.com) for news on many platforms; and *SecuritySearch.Net* (www.securitysearch.net), a search engine for security issues. ◆



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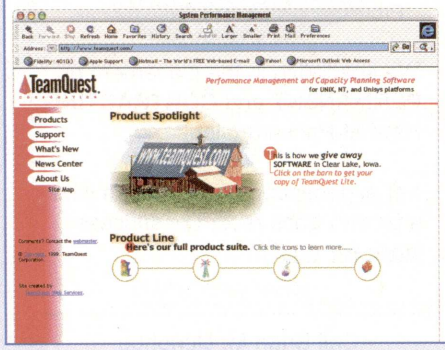
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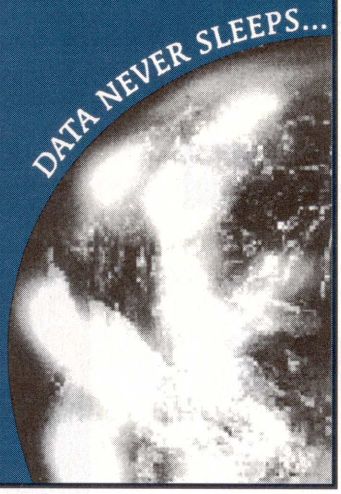
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Big Ten *Continued from page 14*

received word that we were going to really do the project," comments Gothard. "We started working on it at the beginning of the year and it went live in June. That's pretty significant." Phase I included those things that were relevant to new students who were going to be on campus through the summer signing up for classes.

Phase II. This phase came out in August 1999 and added a significant amount of the financial-aid information. In addition to viewing financial-aid application data and award status, students could track their loan applications and checks. Students with incomplete applications had online access to personalized instructions for providing their missing data.

Phase III. When implemented, Phase III will include several enhancements, including ways to collect an alternate billing address for students who want to be billed someplace other than their home address. The Purdue staff is confident that this phase will be easy to implement. As Yuochunas remarks, "I guess the two points I'd like to make are, first, we're really quite happy with VisualWorks. And second, a key factor to our success has been the talent of the staff that is using the tool. They really understand its capabilities and have taken full advantage of its potential."

As they indentify the requirements and the project scope is better defined, the staff knows the implementations will go smoothly, thanks to the power of their interactive development environment.

WHERE TO NOW?

Purdue projects the entire Student Services System to be a 7- to 9-year project, with major functionality being delivered about every 12 to 18 months. And they intend to have at least three projects running concurrently. As they identify the requirements and the project scope is better defined, the staff knows the implementations will go smoothly, thanks to the power of their interactive development environment made possible with Cincom Smalltalk technology and their HP-UX platform.

And how does Purdue think they will face the future and all the challenges to come? As the Executive Director of Management Information for Purdue, Laverne Knodle, comments, "We all know that there are changes coming in higher education. None of us know exactly what those changes are going to be or how fast they're going to come. But, we feel that since we put this type of flexible system in place, we are in a better position to respond to these changes in a timely manner." ◆

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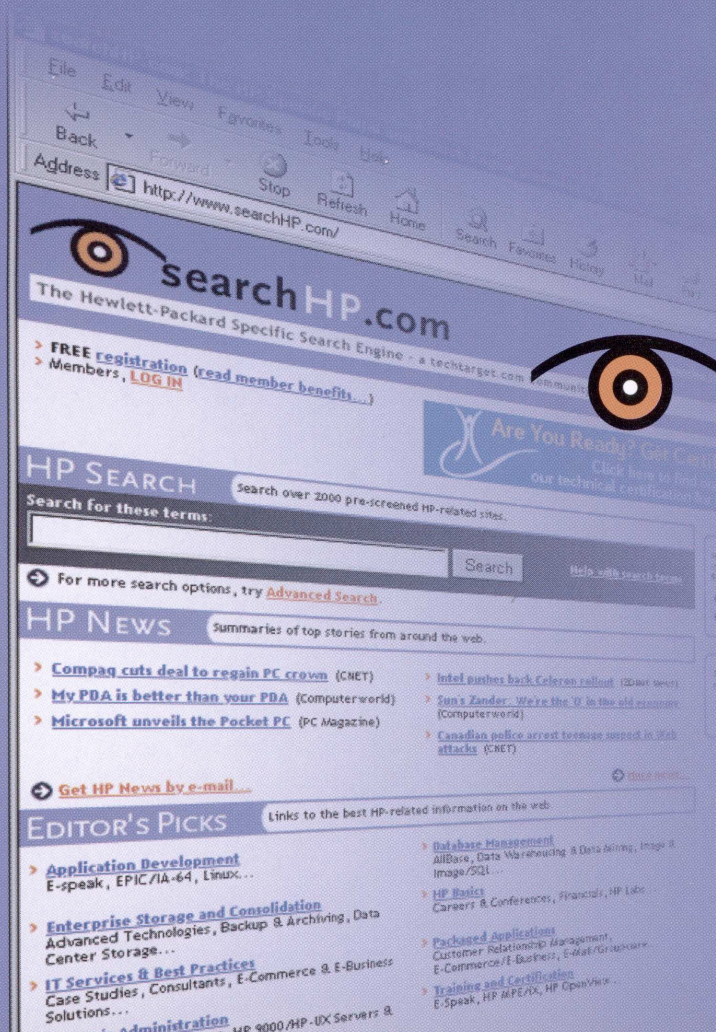
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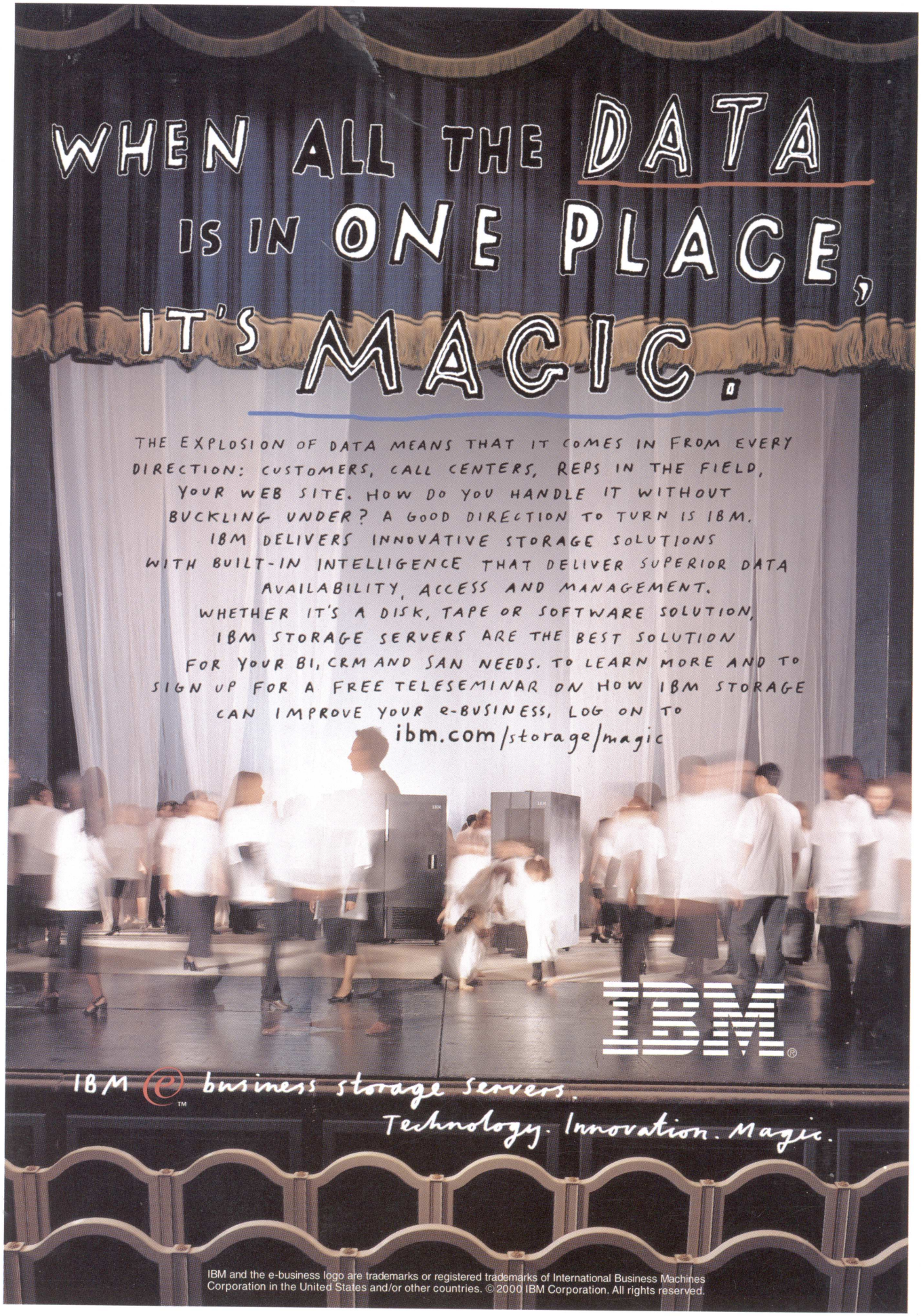
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